



**RISK OF DECOMPRESSION SICKNESS
IN SHALLOW NO-STOP AIR DIVING:
AN ANALYSIS OF NAVAL SAFETY CENTER DATA
1990-1994**

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The experiments reported herein were conducted according to the principles set forth in the current edition of the "Guide for the Care and Use of Laboratory Animals," Institute of Laboratory Animals Resources, National Research Council.

This technical report has been reviewed by the NMRI scientific and public affairs staff and is approved for publication. It is releasable to the National Technical Information Service where it will be available to the general public, including foreign nations.

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12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Naval Safety Center (NSC) dive and incident reports for calendar years 1990-1994 were analyzed to determine the risk of decompression sickness (DCS) in shallow no-stop air diving using current U.S. Navy no-decompression limits (USN57). Navy and Marine Corp divers performed 163,400 no-decompression dives between 21 and 55 feet of sea water (fsw) during this period and reported 48 incidents that could be interpreted as DCS. The overall DCS rate was 0.29 cases/1000 dives. There was a clear pattern of increasing DCS risk with increasing bottom time. The DCS rate in the 4th quartile of USN57 no-decompression time (1.28 cases/1000 dives) was nearly six times the rate in the 1st quartile (0.22 cases/1000 dives). Nevertheless, the DCS rate even in the 4th quartile of USN57 no-decompression time was still quite low in absolute terms. The majority of the 48 incidents reported to NSC were labelled Type II DCS. This is in marked contrast to previous reports of military diving operations where Type I cases predominate.					
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The potential impact of adopting new and more restrictive no-decompression limits (USN93) was examined. If the new limits were adopted in the context of single-level dive tables similar to the current Standard Air Tables, and if the pattern of Navy diving remained unchanged, approximately 2.9% of the no-decompression dives conducted between 21 and 55 fsw would be converted to decompression-requiring dives. Approximately 954 dives would be affected annually, adding 419 hours of decompression time to operations each year assuming the decompression was computed using the proposed new USN93 tables. This is an average of 26.3 minutes of decompression for each dive over the new limit. The observed DCS case rate for dives over the proposed USN93 limit is 1.26 cases/1000 dives, a rate very similar to the USN57 4th quartile rate. With the institution of decompression for these dives, the DCS case rate could be expected to fall from 1.26 cases/1000 dives to 1.07 cases/1000 dives, a 15% reduction. In absolute terms, this is an expected reduction of 0.18 case/year.

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BACKGROUND

During the 1980s, surveys of operational diving practice (1-4) as well as experimental work at NEDU (5) demonstrated that decompression was inadequate for long, deep air dives. When performed with either in-water decompression or surface decompression techniques, these dives were associated with an unacceptable bends rate (5). Experimentally, Thalmann demonstrated that a 150 feet of sea water (fsw) for 40 min dive or a 190 fsw for 30 min dive required 1.6 times the decompression time called for in the U.S. Navy Standard Air Decompression Table (USN57). Similarly, a 60 fsw/180 min dive required 2.7 times as much decompression (5). In the mid 1980's, concern about the safety of air decompression was so great that the U.K. Department of Energy issued two Diving Safety Memoranda (6) that severely restricted the depth-time envelope for air diving in the North Sea.

In response to these concerns, and to restore the operational envelope for air diving, new decompression models and procedures were developed by several groups including the U.S. Navy, the French Navy, COMEX S.A. (subsequently adopted by the French Ministry of Health), the Canadian Forces, the University of Pennsylvania (for the U.K. Health and Safety Executive and SubSea International, Inc.), and Duke University (for its support of Turkish archaeological expeditions). Some of these new decompression models continued with the traditional Haldanian (17) approach while others incorporated probabilistic features and risk based on computed bubble dynamics.

The U.S. Navy developed and extensively tested a new probabilistic decompression model in 1993 (7-9). This model, referred to as USN93, produced a new set of air decompression procedures that corrected perceived deficiencies in the decompression from long, deep dives. However, this model also shortened the allowed no-decompression bottom times for shallow dives when compared to USN57. At 40 fsw, for example, USN93 shortened the no-decompression limit from 200 minutes to 144 minutes. At 35 fsw, the no-decompression limit was shortened from 310 to 185 minutes. Table 1 summarizes the changes.

The USN93 model recommendations for shortening the shallow no-decompression limits were consistent with the recommendations of others. The new COMEX tables set a no-

decompression limit of 165 minutes at 40 fsw, while the new University of Pennsylvania tables allowed only 120 minutes. Nevertheless, the need for shorter no-decompression limits was seriously questioned by the Fleet (10). The Fleet maintained that no-decompression diving in the U.S. Navy had an excellent safety record and that shorter no-decompression limits were both mission-compromising and unnecessary.

As a part of its review of USN93-based decompression procedures for Fleet introduction, the Naval Sea Systems Command (NAVSEA) (11) requested that the Naval Medical Research Institute (NMRI) assess the historical DCS rate for shallow, no-decompression air diving in the U.S. Navy using the USN57 procedures. This paper reports the results of that assessment and estimates the potential impact of adopting the USN93 no-decompression limits.

Table 1
Comparison of USN57 and USN93 No-Decompression Limits
for Shallow Water Air Diving

Depth Range (fsw)	USN57 (min)	USN93 (min)
21-25	Unlimited	338
26-30	Unlimited	245
31-35	310	185
36-40	200	144
41-45	100	114
46-50	100	93
51-55	60	77
56-60	60	64

METHODS

The assessment was performed using data archived in the Naval Safety Center (NSC). The NSC was asked to identify all air dives in its database that met the following criteria:

- a. Were performed in the five-year period between 01 January 1990 and 31 December 1994.
- b. Were performed by Navy, Marine, Reserve, or Civilian divers as coded in Box A-10 of DD Form 2544.
- c. Were performed in open water as coded in Box B-16.
- d. Were to a maximum depth of 21-55 fsw as coded in Box B-29.
- e. Were labelled as "Air Diving, No-decompression", code "A" in Box C-34.

Dives reported to NSC by other Department of Defense components (e.g. Army, Coast Guard) were not included because incident reporting for these components was felt to be incomplete (M. Bonnin, NSC; personal communication).

Once received from NSC, the data set was scanned for possible errors including duplicate entries, dives with a breathing apparatus not compatible with air diving (LAR V, Mark 15, Mark 16), dives not on 21% oxygen or showing helium in Box B-26, and dives with bottom times exceeding the air no-decompression limits. Dives failing to pass these additional screens were deleted and the remaining dives were aggregated into a spreadsheet in depth increments of 5 fsw from 21-55 fsw and in time increments of both 1 and 10 minutes from 0-360 min. For dives in the 21-25 fsw and 26-30 fsw depth ranges, additional time categories of 6-8 h, 8-10 h, 10-12 h and >12 h were added to accommodate dives longer than 360 min. From this spreadsheet, frequency distributions of dives by depth, bottom time and performer were created.

The NSC was also asked to provide copies of all incident reports bearing a diagnosis of either decompression sickness or arterial gas embolism for the period 01 January 1990 to 31 December 1994. These reports were examined to select those incidents that occurred on open-water, air, no-decompression dives between 21 and 55 fsw. These incidents were then reviewed by a panel of five NMRI undersea medical officers who segregated them by consensus vote into one of three categories: (1) Definitely Decompression Illness (DCI), (2) Definitely not DCI, and (3) Uncertain whether it is DCI or not. Category 1, Definitely DCI, was further divided into three subclasses: (a) Decompression Sickness (DCS), (b) Arterial Gas

Embolism (AGE), and (c) DCS or AGE. This categorization scheme recognizes the fact that it is frequently impossible to tell whether an illness observed following decompression represents DCS or AGE (12). The selected incidents were also checked against the dive database to ascertain that the causative dive was included in the database and the depths and bottom times of the dive and the accident reports matched.

Prior to any analyses, all incidents categorized as Definitely not DCI by the panel of undersea medical officers were eliminated from the data set. Also, those incidents where both NSC and the panel of undersea medical officers agreed that the case was a definite AGE were eliminated. This left only those cases where the diagnosis was either (1) Definite Decompression Sickness or (2) Possible Decompression Sickness. All equivocal cases that might have been decompression sickness were thus retained in the analysis.

The DCS rate was computed by dividing the number of cases observed by the number of dives performed, then multiplying the quotient by 1000 to express the rate in cases/1000 dives. The DCS rate was computed by depth band alone (*e.g.*, 21-25 fsw), by depth band and whether the dive was shorter or longer than the USN93 no-decompression limit, and by depth band and whether this dive was in the first, second, third, or fourth quartile of the USN57 no-decompression time. Rates across depth bands were also computed. The relative risk of one condition compared with another was computed by dividing the rate in that condition by the rate in the reference condition. Tests of statistical significance were not conducted because of the small number of DCS cases in the data set.

RESULTS

The NSC identified 166,443 dives based on the criteria (a - e) outlined above. Of these dives, 863 were found to be duplicate entries, 223 to have bottom times exceeding the current no-decompression limit, and 1,957 that were not entirely air dives. These invalid entries represented approximately 2% of the data received from NSC and when they were eliminated from the data set, 163,400 dives remained for analysis. The refinement of the NSC data set is summarized in Table 2.

Table 2
Refinement of the Naval Safety Center Data set

Initial NSC Total	166,443
Eliminate Non-Air Dives	
LAR V 1154	
Mark 15 414	
Mark 16 287	
SL-17, 100% O ₂ 90	
HeO ₂ 12	
	-1,957
Eliminate Dives Longer than No-D Limit	
	-223
Eliminate Duplicate Entries	
	-863
Final NSC Total	163,400

Duplicate entries represented one-half of one percent of the data set. Usually two entries were made, one with the diver's full name and one with his initials. In one instance, two dives with the same diver had an identical date and surfacing time, but the time recorded for leaving the surface differed by 2 minutes.

A number of dives (n=223; 31-55 fsw) listed as "no-decompression" actually exceeded the USN57 no-decompression limit. In some instances, the reported bottom time was just over the limit. Some reported dives, however, were well over the limit. At 36-40 fsw, for example, 16 dives were reported with bottom times of 271-290 minutes (No-decompression limit = 200 min). Across the depth range of 31-55 fsw, 28 "no-decompression" dives were reported with bottom times in excess of 6 hours!

A unique situation was discovered in 32 records. In these records, the day of the month the dive was performed was entered into the day column of the bottom time field, resulting, for example, in a no-decompression dive to 32 fsw for 23 days, 0 hours, and 13 minutes. Such errors were corrected and these dives were retained in the database. They are not part of the 223 dives over the limit described above.

Dives performed with the LAR V, Mark 15, and Mark 16 and listed as air no-decompression may have been SPECWAR dives in which these rigs were used for part of the time in what otherwise was an air dive. Alternatively, they may have been no-decompression dives on those respective rigs in which code "A" in Box C-34 of DD 2544 was checked in error. No attempt was made to verify the nature of these dives. They were eliminated from the dataset.

Table 3 shows the distribution of the 163,400 dives by depth range and performer. More detailed information is given in Appendix A. The greatest number of dives occurred in the 26-30 fsw depth range. Eighty-two percent of the dives were between 21 and 40 fsw. Active duty and civilian Navy divers performed more than 90% of the dives. Within Navy, the ratio of active duty dives to civilian dives was approximately 3 to 1.

Table 3
Distribution of Dives by Depth Range and Performer

Depth Range (fsw)	Total Dives	Navy	Civilian	Marine	Reserve
		(% within depth range)			
21-25	29,325	75.8	13.4	4.7	6.2
26-30	43,455	68.0	24.7	2.4	4.9
31-35	28,621	72.4	22.2	1.8	3.5
36-40	33,198	64.1	29.8	1.7	4.4
41-45	11,415	75.6	18.0	1.8	4.6
46-50	13,302	65.2	28.5	2.0	4.2
51-55	4,084	78.5	12.2	3.6	5.7
Total	163,400	70.0	22.8	2.5	4.7

Figure 1 shows the frequency distribution of dives across all performers as a function of bottom time. For all depth ranges under study, the frequency rises rapidly with increasing bottom time, reaching a peak at 21-30 minutes. Frequency then declines with a long tail until the no-decompression time is reached. A secondary peak in dive frequency is not seen as the no-decompression limit is approached. This suggests that divers are not pushing the no-decompression limit. Appendix A gives a further breakdown of these time distributions by category of performer.

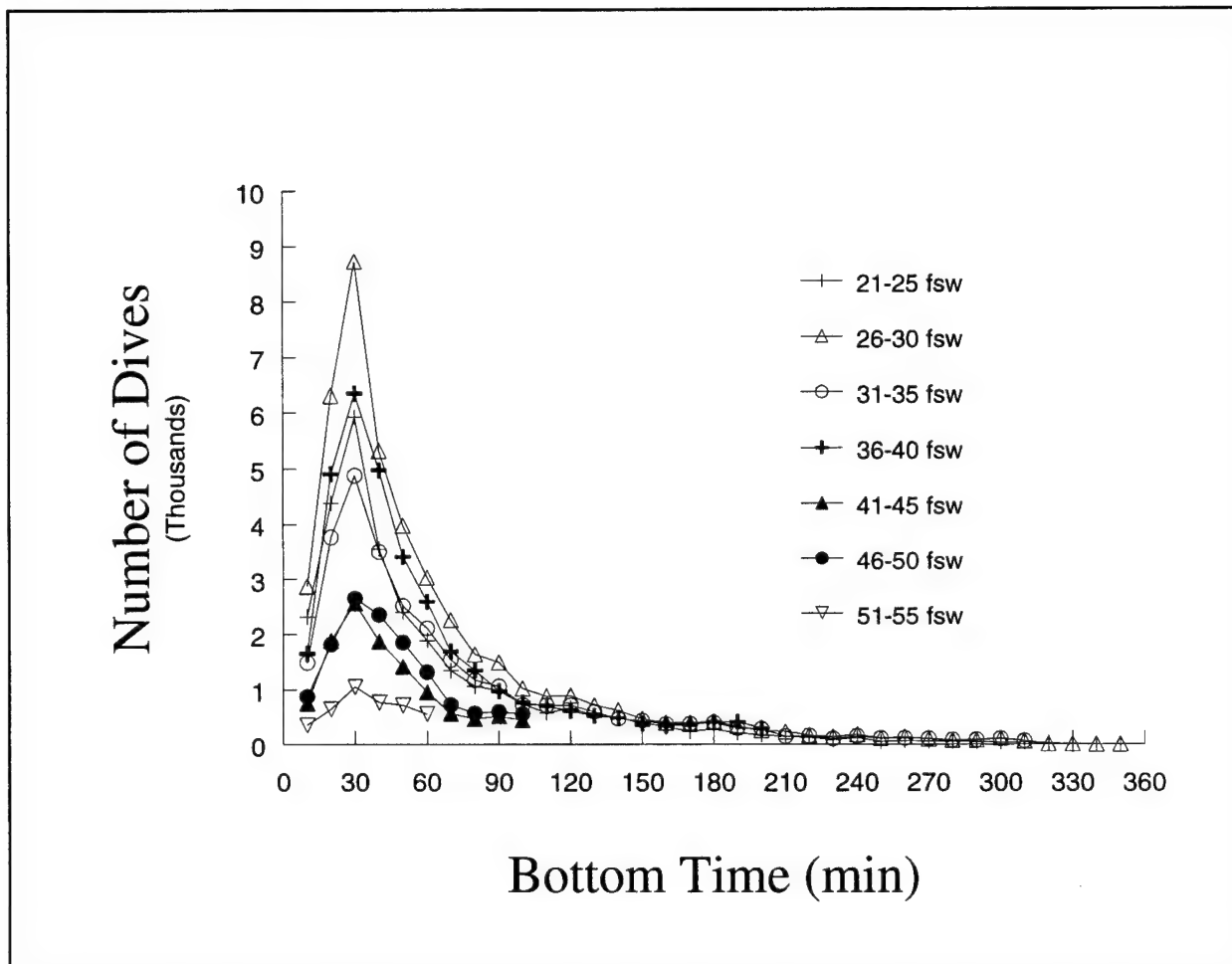


Figure 1. Frequency Distribution of No-Decompression Dives as a Function of Bottom Time. The number of dives performed in each 10 minute increment of bottom time from zero to the USN57 limit is shown for all 7 depth ranges studied. Numbers are the sum of values for Navy, Civilian, Marine, and Reserve divers. At all depths the highest frequency is observed between 21 and 30 min of bottom time.

Figure 2 shows the frequency distribution of dives by the maximum reported depth (Box B-29, DD 2544). Substantial spikes in dive frequency are observed at increments of 5 and 10 fsw, suggesting rounding up of the actual maximum depth of the dive to the next deeper 5- or 10-fsw depth. Spikes at the 10-fsw mark consistently exceed those at the 5-fsw mark, suggesting further that rounding up to the next deeper 10-fsw depth is the more common practice.

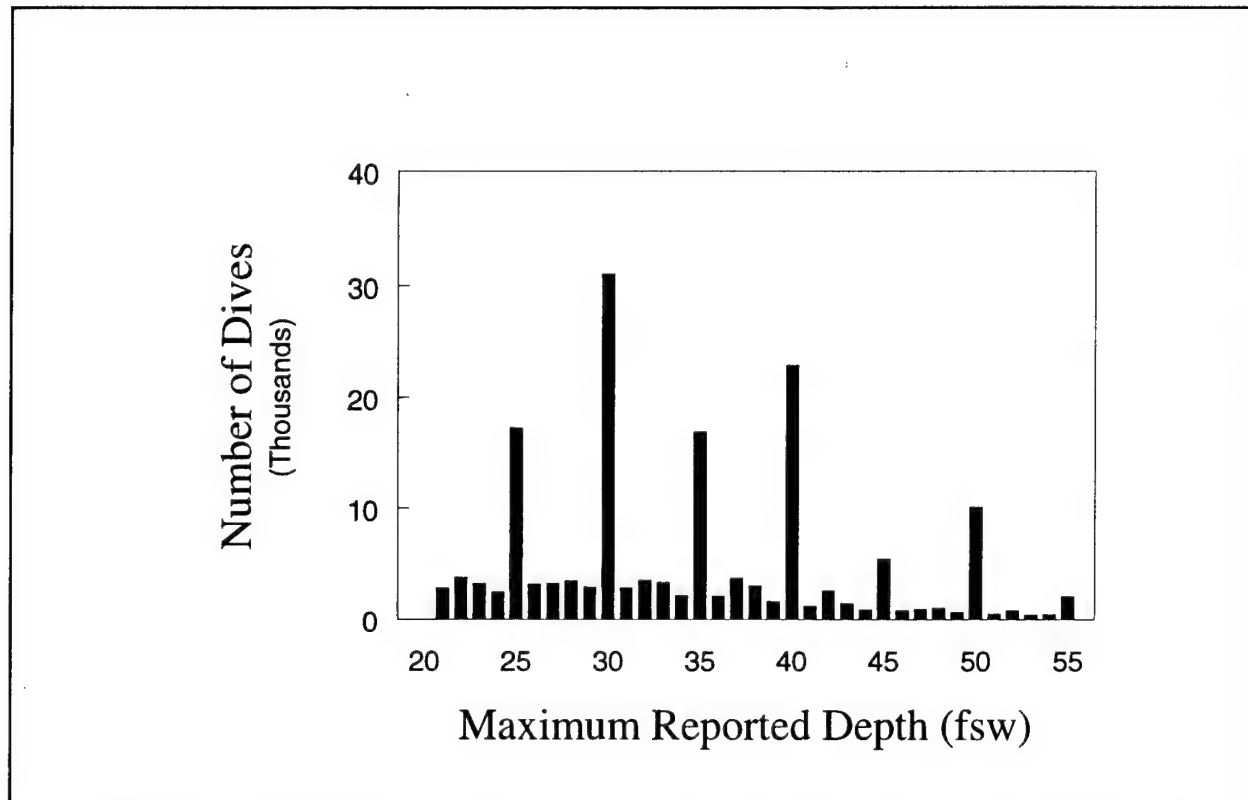


Figure 2. Frequency Distribution of Dives by Maximum Reported Depth. Pronounced peaks are observed at 5- and 10-fsw intervals indicating rounding up of maximum depth to the next 5- or 10-fsw mark.

Figure 3 shows the frequency distribution of dives by the last digit of the reported bottom time (Box B-30, DD 2544). Zero represents dives of 10, 20, 30 min, etc, while 5 represents dives of 5, 15, 25 min, etc. A substantial spike is present at 0, suggesting rounding up the bottom time to the next 10-minute mark. There also appears to be some rounding up to the next 5 minutes as well, although the evidence for this is less strong.

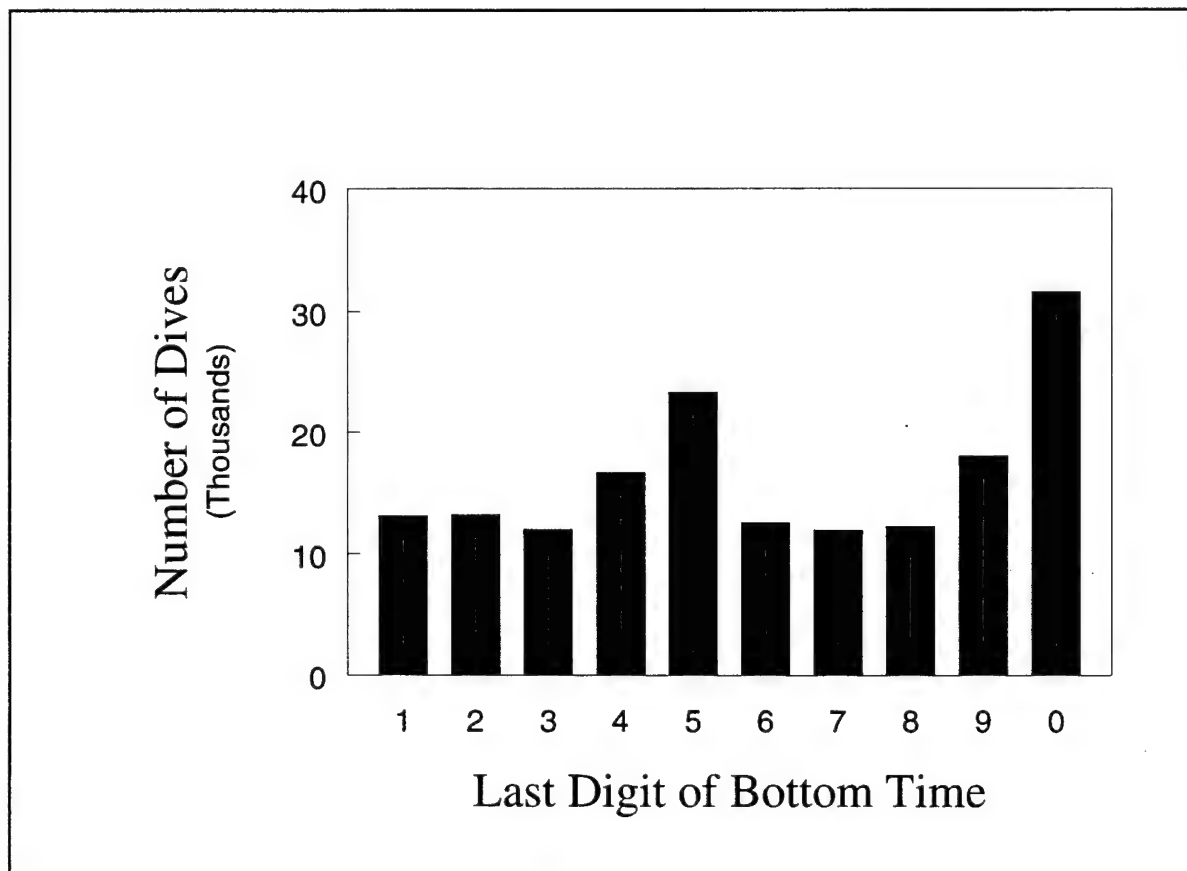


Figure 3. Frequency Distribution of Dives by Last Digit of Reported Bottom Time. The highest frequencies are observed at 5 and 0 suggesting some rounding up of bottom time to the next 5 or 10 minute mark.

For dives to 30 fsw and shallower, the USN57 no-decompression limit is infinite. Table 4 shows the number of dives between 21 and 30 fsw that were reported to be greater than 6-hours duration. Fifty-eight dives were identified in this category; 11 of these dives had reported durations greater than 12 hours.

Table 5 shows the number of dives reported between the USN93 no-decompression

limit and the USN57 limit for the depth range indicated. The blank entries for 41-45 and 51-55 fsw reflect the fact that the USN93 limit is more permissive than the USN57 limit in these ranges. All dives conducted between the USN93 limit and the USN57 limits in these two ranges therefore would have been labelled decompression dives under current rules and as such were not captured for this analysis.

Table 4
Air No-Decompression Dives Longer than Six Hours

Depth Range (fsw)	Duration (hours)				Total
	6-8	8-10	10-12	>12	
21-25	16	3	2	5	26
26-30	13*	7	6	6	32
Total	29	10	8	11	58

*Two incidents reported (see Table 7 below)

Table 5
Number of Dives Between USN93 and USN57 No-Decompression Limits

Depth Range (fsw)	≤ USN93	≤USN57	Between
21-25	29,291	29,325	34
26-30	42,791	43,455	664
31-35	26,970	28,621	1651
36-40	31,143	33,198	2055
41-45	--	--	--
46-50	12,976	13,302	366
51-55	--	--	--
Total			4770

Approximately 4,770 dives between 21 and 55 fsw would be converted from no-decompression dives to decompression dives in a 5 year period by adopting the USN93 limit in a single level dive format (Table 5). This represents 2.9% of the total dives conducted in this depth range. The word "approximately" is used because the dives falling between the USN93 and USN57 limits in the depth ranges of 41-45 and 51-55 fsw would actually be converted in the opposite direction, from decompression dives to no-decompression dives, making the total number of dives converted to decompression dives over the full depth range of 21-55 fsw less than 4,770. The precise reduction from 4,770 cannot be determined.

A total of 60 DCS/AGE incidents on open-water, air no-decompression dives were identified from the material provided by NSC. Of these, NSC considered 31 cases to represent DCS while 29 were considered AGE. Of the 31 DCS cases, 27 (87%) were reported by NSC as Type II DCS.

The NMRI panel of undersea medical officers felt that 36 of the 60 cases were definitely decompression-related (Definitely DCI), 7 were definitely not decompression-related (Definitely not DCI), and 17 were equivocal (*i.e.*, they may or may not have been decompression-related). For the cases labelled Definitely not DCI, symptoms were already present during the bottom phase of the dive or the diver failed to show any response to recompression therapy. Of those cases labelled Definitely DCI by the panel, 18 were felt to be DCS, 5 to be AGE, and 13 to be either DCS or AGE. After eliminating 7 cases considered Definitely Not DCI and 5 cases where both NMRI and NSC agreed on the diagnosis of AGE, 48 cases remained for analysis. One of the 7 cases eliminated as definitely not DCI had a bottom time longer than the USN93 limit (265 min at 28 fsw). The remaining 6 definitely not DCI cases and the 5 AGE cases all had bottom times shorter than the USN93 limit.

There was generally very good agreement between the depth/bottom time information provided on the incident report and the information contained in the dive database for the causative dive. There were some instances, however, where there were discrepancies. In one instance, the dive was reported as 90 minutes; the incident report indicated 91 minutes. In another instance, the dive record and the incident report numerical data both indicated a depth of 22 fsw, but the incident report narrative indicated a depth of 29 fsw. In a third instance, the dive record and incident report numerical data indicated a bottom time of 52 minutes, but the incident report narrative indicated 51 minutes. In a fourth instance, the dive record and

incident report numerical data indicated a depth of 26 fsw, while the incident report narrative indicated a depth of 30 fsw. Since there was agreement between the dive record and the incident report numerical data in the latter three instances, these values were used in the analysis. In the first instance, the 90-minute bottom time from the dive record was used.

Table 6 shows the distribution of incidents by bottom time within each depth range. Cases indicated by bold print lie beyond the USN93 limit. The shortest bottom time for a case was 13 minutes, the longest was 397 minutes. Within each depth range, cases appeared across the range of bottom times, with no evidence of clustering near the no-decompression limits.

Table 6
Distribution of Incidents by Bottom Time

Depth Range (fsw)	Bottom Time (min)
21-25	29,40,40,44,44,63,90,140
26-30	17,22,25,30,45,50,61,73,74,135, 397,397
31-35	43,52,52,76,115,143, 191,278
36-40	20,30,50,74,91,113,121,134, 176,189
41-45	15,46,97
46-50	40,52,52,57
51-55	13,46,58

Figure 4 shows the percentage of total cases observed in the 26-30, 31-35, and 36-40 fsw depth ranges as a function of the bottom time expressed as percentage of the USN57 no-decompression limit. These are the depth ranges where implementation of the USN93 limit would have the greatest impact (see Table 5). For purposes of this analysis the USN57 no-decompression limit at 26-30 fsw was considered to be 400 minutes; in fact, it is infinite. For all three depth ranges, 70% or more of the cases are observed in the first 60% of the no-decompression time. For the 26-30 fsw range, nearly 80% of the cases are observed in the first 20% of the no-decompression time. (Note: This result would be even more striking if a no-decompression limit greater than 400 min had been selected for this depth range.) The

unexpectedly large number of cases at bottom times well short of the no-decompression limit is a reflection of the very large number of dives performed at these short times (see also the discussion below).

Six of the 48 cases (12.5%) occurred at bottom times between the USN93 limit and the USN57 limit. Table 7 summarizes the essential features of these cases. Appendix B gives greater detail. Three of the cases were from ship husbandry operations; three from special-warfare operations. All but one case demonstrated some form of neurological involvement. The NSC labelled two of the cases AGE, the remaining four DCS. The NMRI review panel felt one of the cases labelled AGE by NSC was in fact DCS; the other case labelled AGE by NSC was considered equivocal (*i.e.*, could have represented either DCS, AGE, or was not-decompression related). The first two cases occurred on the same dive.

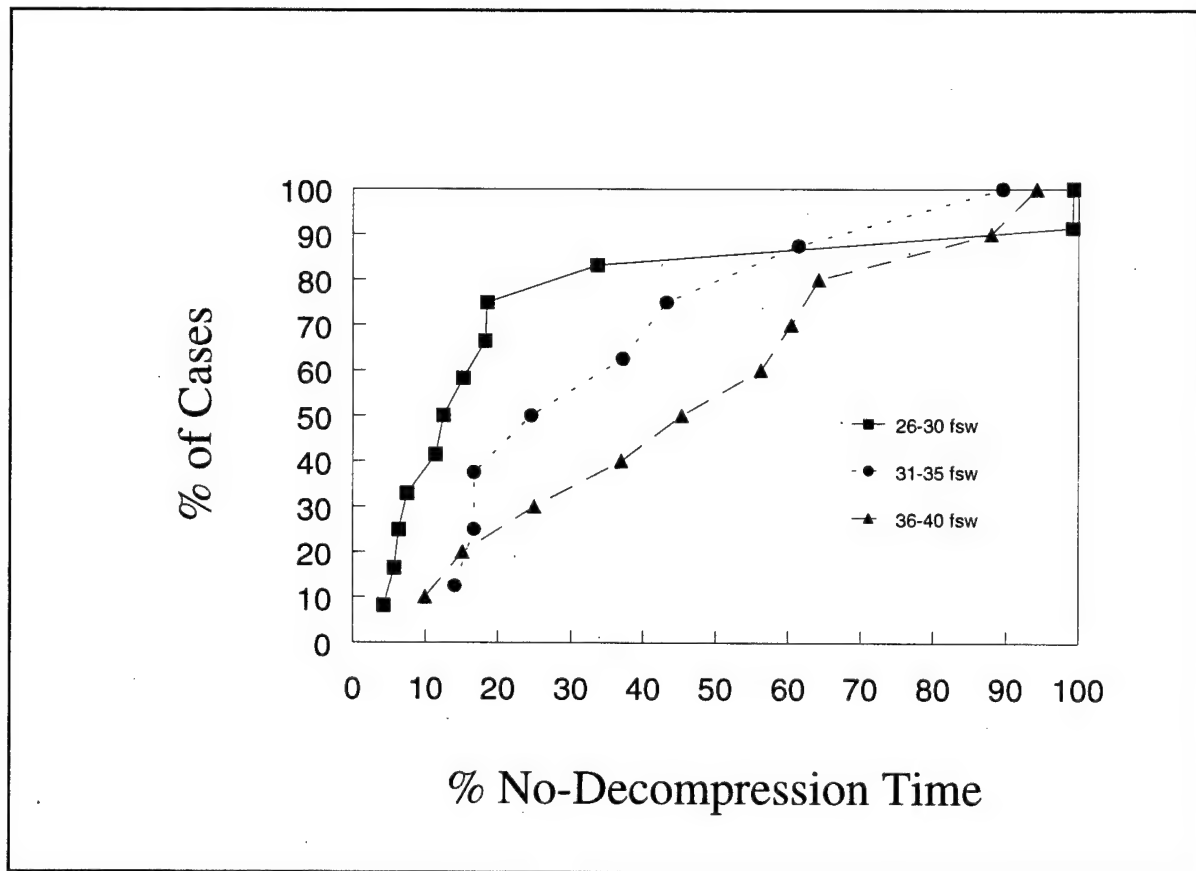


Figure 4. Percentage of Cases Observed as a Function of the Fraction of USN57 No-Decompression Time. Most of the reported cases are observed well before the no-decompression limit is neared.

Table 7
Cases Occurring Beyond the USN93 No-Decompression Limit

Dive (fsw/min)	Purpose	Symptoms	Diagnosis	
			NSC	NMRI
30/397	SW/SDV	Neuropsychiatric	DCS TYPE 2	EQV
30/397	SW/SDV	Numbness	DCS TYPE 2	DCS
33/278	SW/DDS	Back Pain	DCS TYPE 1	DCS
34/191	SH	Hearing Loss	AGE	EQV
37/176	SH	Pain/Weakness	AGE	DCS
40/189	SH	Pain/Numbness	DCS TYPE 2	DCS

SW-special warfare; SDV-swimmer diver vehicle; DDS-dry deck shelter;
EQV-equivocal case, may or may not have been decompression-related.

Table 8 shows the DCS rate (cases/1000 dives) by depth interval without regard to bottom time. The rate is remarkably constant, ranging between 0.26 and 0.30 cases/1000 dives (2.6-3.0 cases/10,000 dives) across the entire range of 21 to 50 fsw. Only between 51 and 55 fsw does the rate increase to 0.73 cases/1000 dives.

Table 8
DCS Rate as a Function of Depth Range

Depth Range (fsw)	Bottom Time (min)	Total Dives (#)	Total Cases (#)	Rate (cases/1000)
21-25	0-INF	29,325	8	0.27
26-30	0-INF	43,455	12	0.28
31-35	0-310	28,621	8	0.28
36-40	0-200	33,198	10	0.30
41-45	0-100	11,415	3	0.26
46-50	0-100	13,302	4	0.30
51-55	0-60	4,084	3	0.73
Total		163,400	48	0.29

Table 9 shows the DCS rate further segregated into quartiles of USN57 no-decompression time. At 21-30 fsw, where the USN57 limit is infinite, four quartiles of 100 minutes each were arbitrarily chosen, allowing the analysis to cover 400 minutes of bottom time and to encompass all of the observed cases of DCS. This process excluded 43 dives beyond the 400-minute mark from the analysis.

Overall, the quartile analysis shows a steadily increasing DCS rate from quartile to quartile, ranging from 0.22 cases/1000 dives in the first quartile to 1.28 cases/1000 dives in the fourth quartile. The DCS rate in the fourth quartile is 2.2 times the rate in the 3rd quartile and 5.8 times the rate in the first quartile.

Figure 5 plots the cumulative number of DCS cases at 26-30, 31-35, and 36-40 fsw as a function of the cumulative number of dives undertaken beginning at a bottom time of 1-10 minutes and then proceeding to progressively longer bottom times. If the DCS rate was a constant value independent of bottom time, these plots would be expected to be straight lines with a y-intercept of zero and a slope equal to the DCS rate. At each depth, the curves bow upward indicating a rising DCS rate with increasing bottom time. The information plotted in Figure 5 is from Appendix A and Table 6.

Table 10 shows the DCS rate within each depth range when the dives are segregated into those equal to or shorter than the USN93 limit and those longer than the USN93 limit. The latter are the dives that would be converted to decompression dives by adopting the USN93 limit. The depth ranges 41-45 and 51-55 fsw are not shown since the USN93 limit exceeds the USN57 limit in these ranges. For dives equal to or shorter than the USN93 limit, the mean DCS rate is 0.26 cases/1000 dives (range 0.22-0.31). Longer than the USN93 limit, the mean DCS rate is 1.26 cases/1000 dives (range 0-3.01), a 4.8-fold increase over those dives equal to or shorter than the limit.

Table 9

DCS Rate as a Function of Quartile of No-Decompression Time

Depth Range (fsw)	Bottom Time (min)	Total Dives (#)	Total Cases (#)	Rate (#/1000)
21-25	0-100	24,584	7	0.28
	101-200	3,867	1	0.26
	201-300	775	0	0.00
	301-400	80	0	0.00
26-30	0-100	36,641	9	0.25
	101-200	5,370	1	0.19
	201-300	1,330	0	0.00
	301-400	90	2	22.22
31-35	0-78	20,701	4	0.19
	79-155	5,175	2	0.39
	156-233	1,981	1	0.50
	234-310	764	1	1.31
36-40	0-50	21,300	3	0.14
	51-100	7,374	2	0.27
	101-150	2,704	3	1.11
	151-200	1,820	2	1.10
41-45	0-25	3,826	1	0.26
	26-50	4,646	1	0.22
	51-75	1,743	0	0.00
	76-100	1,200	1	0.83
46-50	0-25	3,862	0	0.00
	26-50	5,679	1	0.18
	51-75	2,347	3	1.28
	76-100	1,414	0	0.00
51-55	0-15	651	1	1.54
	16-30	1,394	0	0.00
	31-45	1,139	0	0.00
	46-60	900	2	2.22
Summary	1 st Quartile	111,565	25	0.22
	2 nd Quartile	33,505	8	0.24
	3 rd Quartile	12,019	7	0.58
	4 th Quartile	6,268	8	1.28
TOTAL		163,357	48	0.29

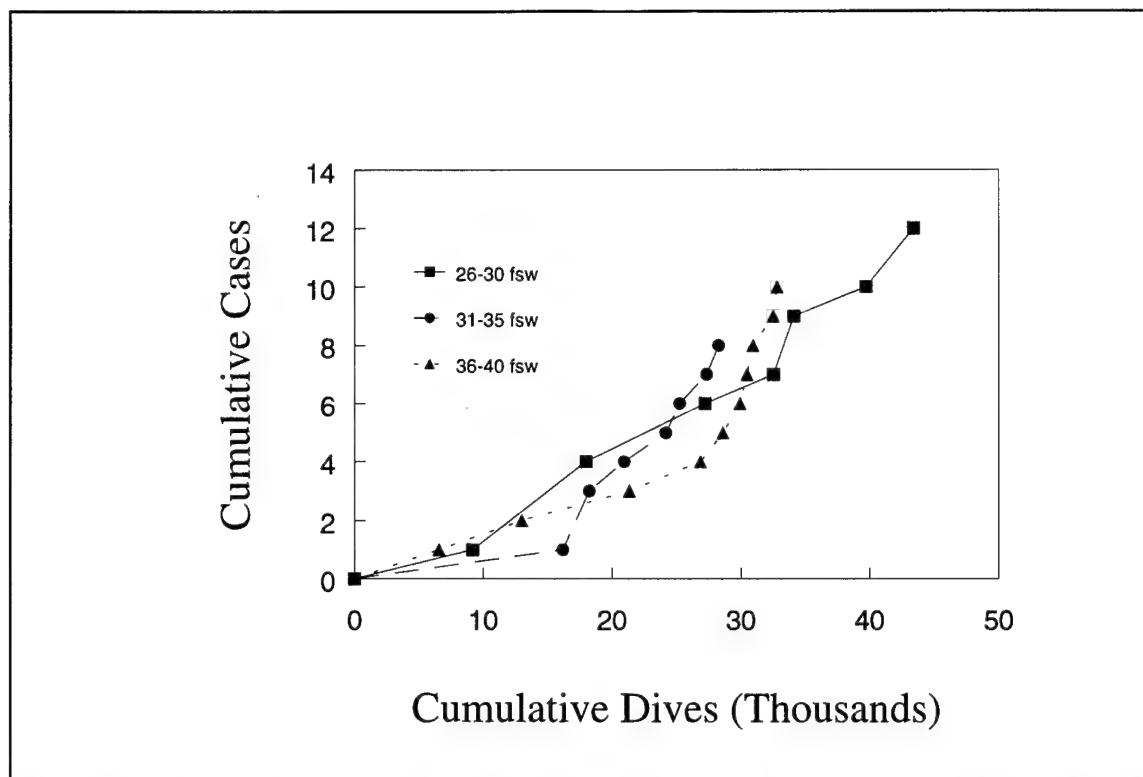


Figure 5. Cumulative Number of Cases versus Cumulative Number of Dives Undertaken. At the three depths shown, the curves tend to bow upward suggesting the DCS rate is rising with increasing bottom time.

Table 10
DCS Rate for Dives Shorter or Longer than the USN93 Limit

Depth Range (fsw)	Shorter than USN93 Limit			Longer than USN93 Limit		
	Dives (#)	Cases (#)	Rate (#/1000)	Dives (#)	Cases (#)	Rate (#/1000)
21-25	29,291	8	0.27	34	0	0.00
26-30	42,791	10	0.23	664	2	3.01
31-35	26,970	6	0.22	1651	2	1.21
36-40	31,143	8	0.26	2055	2	0.97
41-45	11,415	3	0.26	--	-	--
46-50	12,936	4	0.31	366	0	0.00
51-55	4,084	3	0.73	--	-	--
Total	158,630	42	0.26	4770	6	1.26

DISCUSSION

The epidemiologic data that the NSC collects on U.S. military diving operations is among the best in the world today. Nevertheless, we found that these data sets were not error-free. Approximately 2% of the diving records we examined had to be excluded from the study because they represented duplicate entries, had listed bottom times in excess of the air no-decompression limits, or listed a breathing apparatus inconsistent with air diving (*e.g.*, LAR V). We observed that reported maximum depth was usually rounded up to the next even increment of 5 or 10 fsw. Reported bottom time appeared to be rounded up as well.

Incident reports occasionally contained conflicting depth and time information. By far the more limiting feature of the incident report, however, was the quantity and quality of the information contained in the narrative section. These narratives, containing 100-200 words, provided scant information on the clinical presentation of the cases (see Appendix B for examples). The information was so brief that the panel of undersea medical officers in seven cases could not conclude whether the case was related to decompression or not. The narratives appeared to be written largely by non-medical personnel, and in the cases where two divers from the same dive were treated, the narratives were nearly identical for both divers (see Appendix B). A different categorization may have been reached by the panel if full narrative summaries of the incidents written by the attending physician or corpsman had been available for examination.

Eighty-seven percent of the cases reported to NSC as DCS were labelled Type II. The prominence of Type II symptoms was surprising given previous reports of the experimental and operational experience of professional divers (13,14,15) in which Type I symptoms are the dominant manifestation of DCS. The finding of a high prevalence of Type II symptoms is consistent, however, with recently reported observations in recreational divers (15,16) for whom, as a class, medical monitoring and incident reporting are highly variable.

For all depth ranges, the incidents of definite and possible DCS were distributed broadly over the range of bottom times up to the USN57 no-decompression limit. The cases were not clustered near the no-decompression limit as might be expected. In fact, most cases were observed in the first quartile of the no-decompression time, and can be attributed to the

high frequency of diving at these short bottom times (see Figure 1 and Table 9), not to a higher risk level. Experience has shown that DCS can occur after almost any hyperbaric exposure, even very short and shallow ones. Although the probability of DCS on these dives is very low, the sheer number of dives makes the observance of some cases inevitable.

The data show a clear pattern of increasing risk of DCS with increasing bottom time. The DCS rate for the 4th quartile of no-decompression time is 2.2 times the 3rd quartile rate and nearly 6 times the 1st quartile rate. The DCS rate for dives longer than the USN93 limit is 4.8 times the rate for dives shorter than the limit.

Despite the pattern of increasing risk with increasing bottom time, the absolute risk of DCS during no-decompression diving as currently practiced is quite low. For dives falling between the USN93 limit and the USN57 limit, the mean DCS rate is only 1.26 cases/1000 dives. The highest rate observed in this interval is 3.01 cases/1000 dives.

It would have been highly desirable to make point estimates of the DCS rate at the USN93 and USN57 limit times for each depth range rather than estimates for the preceding interval. The DCS rate for dives conducted at the longer USN57 limit, for example, will be clearly greater than the rate for all the dives between the USN93 and the USN57 limit. Unfortunately, the low number of reported cases would not sustain such an analysis.

IMPACT OF ADOPTING THE USN93 NO-DECOMPRESSION LIMITS

The foregoing analysis allows assessment of the likely operational impact of adopting the USN93 no-decompression limits. If the new limits were adopted in the context of single-level dive tables similar to USN57 and the pattern of diving in the Fleet remained unchanged, approximately 954 dives per year (4,770 dives/5 years, see Table 5) would be converted from no-decompression dives to dives requiring decompression. This number is a slight overestimate since a small number of dives in the 41-45 and 51-55 fsw range now requiring decompression would be converted to no-decompression dives. The 954 dives would add approximately 419 hours of decompression time to operations annually assuming that these dives were all square dives to the maximum depth and bottom time indicated in the NSC data and that decompression was computed using the new USN93 tables. This is an average of 26.3 minutes of decompression per dive for this subset of dives.

The institution of decompression for the 954 dives between the USN93 and USN57 limits would reduce the DCS risk below the current risk with no-decompression, but would not eliminate risk altogether. The decompression tables themselves are associated with a finite level of risk. Using the USN93 algorithm, the risk of performing these 954 dives with and without decompression was computed. For this calculation, the 4,770 dives over the USN93 limit for the five-year period were aggregated into a spreadsheet in depth intervals of 5 fsw (*e.g.*, 26 to 30 fsw) and time intervals of 10 minutes (*e.g.*, 251 to 260 minutes). For all dives in the spreadsheet cell, the depth for the calculation was taken as the upper limit of the cell (*e.g.*, 30 fsw for 26-30 fsw) and the bottom time was taken as the mid point of the cell (*e.g.*, 255 min for 251-260 min). For the 4,770 dives in question, the DCS risk with decompression was estimated by the algorithm to be 85% of the risk of performing them without decompression. In other words, the DCS risk is approximately 15% lower with USN93 decompression than without.

Six cases of DCS were observed in 5 years on the 4770 dives performed over the USN93 limit. This gives a baseline risk of 1.26 cases/1000 dives when these dives are performed without decompression. Based on the analysis outlined above, the risk on these dives with the institution of decompression would be expected to fall to 1.07 cases/1000 dives (1.26×0.85). For the 954 dives over the USN93 limit annually, this would result in a rate of 1.02 cases/year with decompression vice 1.20 cases/year without decompression, or the avoidance of 0.18 case/year. This number is a slight overestimate of the benefit since the dives in the 41-45 fsw and 51-55 fsw ranges converted from decompression dives to no-decompression dives would add back in a small risk.

Thus, the best estimate of the cost/benefit of adopting the USN93 limits in the context of single level dive tables is the addition of approximately 419 hours of decompression time annually to operations for the avoidance of 0.18 cases of DCS.

CONCLUSIONS

1. The overall DCS rate for shallow water, air, no-stop diving in the U.S. Navy is very low, approximately 0.29 cases/1000 dives. This overall rate remains nearly constant over the depth range of 21-50 fsw.
2. The observed probability of DCS with shallow no-decompression diving increases with increasing bottom time. The DCS rate during the 4th quartile of USN57 no-decompression time (1.28 cases/1000 dives) is approximately six times the rate in the 1st quartile (0.22 cases/1000 dives). For bottom times longer than the proposed USN93 limit, the DCS rate is 1.26 cases/1000 dives, which is substantially greater than the DCS rate of 0.26 cases/1000 dives for dives shorter than the limit, but still quite low in absolute terms.
3. There is no evidence that divers are currently pushing the no-decompression limits in shallow water. In fact, the vast majority of dives are conducted at less than 25% of the current no-decompression limits for the depth ranges studied here.
4. The proportion of DCS cases reported as Type II in shallow no-stop diving is significantly higher than has been previously reported in military divers.
5. If the USN93 limits were adopted and used in the context of single-level diving tables, approximately 0.18 cases of DCS would be avoided per year at a cost of approximately 419 hours of additional decompression time.
6. These data do not support shortening the USN57 no-decompression limits in shallow water.

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APPENDIX A

FREQUENCY OF SHALLOW AIR NO-DECOMPRESSION DIVING

1990 - 1994

Table A1
Distribution of Dives by Depth and Bottom Time

All Dives

Scuba

B.T. Count		0 to 10		11 to 20		21 to 30		31 to 40		41 to 50		51 to 60		61 to 70		71 to 80		81 to 90		91 to 100		101 to 110		111 to 120		121 to 130		131 to 140		141 to 150		151 to 160		161 to 170		171 to 180		181 to 190		191 to 200		201 to 210		211 to 220		221 to 230		231 to 240		241 to 250		251 to 260		261 to 270		271 to 280		281 to 290		291 to 300		301 to 310		311 to 320		321 to 330		331 to 340		341 to 350		351 to 360		Totals	
0 to 10	11 to 20	21 to 30	31 to 40	41 to 50	51 to 60	61 to 70	71 to 80	81 to 90	91 to 100	101 to 110	111 to 120	121 to 130	131 to 140	141 to 150	151 to 160	161 to 170	171 to 180	181 to 190	191 to 200	201 to 210	211 to 220	221 to 230	231 to 240	241 to 250	251 to 260	261 to 270	271 to 280	281 to 290	291 to 300	301 to 310	311 to 320	321 to 330	331 to 340	341 to 350	351 to 360	Totals																																							
1468	2854	3448	2261	1391	1049	682	442	405	280	224	182	166	134	96	58	80	48	47	34	22	19	34	5	18	15	8	13	4	2	8	3	2	0	1	3	16298																																							
21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85	86-90	91-95	96-100	101-105	106-110	111-115	116-120	121-125	126-130	131-135	136-140	141-145	146-150	151-155	156-160	161-165	166-170	171-175	176-180	181-185	186-190	191-195	196-200	201-205	206-210	211-215	216-220	221-225	226-230	231-235	236-240	241-245	246-250	251-255	256-260	261-265	266-270	271-275	276-280	281-285	286-290	291-295	296-300	301-305	306-310	311-315	316-320	321-325	326-330	331-335	336-340	341-345	346-350	351-355	356-360	Totals							
1617	3058	3518	2918	2065	1541	966	674	613	347	233	252	200	142	114	112	136	69	76	29	30	54	15	37	19	8	7	10	8	1	0	1	0	1	3	14031																																								
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1617	3058	3518	2918	2065	1541	966	674	613	347	233	252	200	142	114	112	136	69	76	29	30	54	15	37	19	8	7	10	8	1	0	1	0	1	3	14031																																								
1617	3058	3518	2918	2065	1541	966	674	613	347	233	252	200	142	114	112	136	69	76	29	30	54	15	37	19	8	7	10	8	1	0	1	0	1	3	14031																																								
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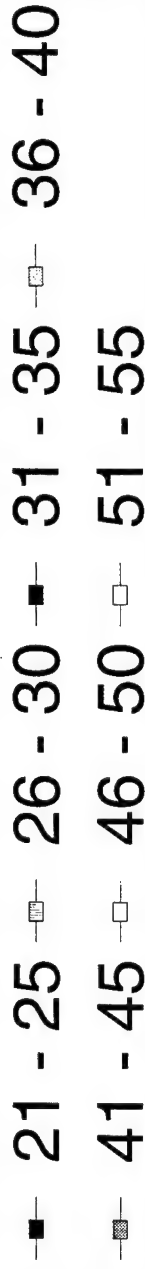
Surface Supplied

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Total

B.T. →		0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100-110	111-120	121-130	131-140	141-150	151-160	161-170	171-180	181-190	191-200	201-210	211-220	221-230	231-240	241-250	251-260	261-270	271-280	281-290	291-300	301-310	311-320	321-330	331-340	341-350	351-360	Total	# Bygs																																																																																																																																																																																																														
Days	21-30	2000	4384	9529	15557	25999	38877	53411	69679	79636	874574	9603527	1063603	1187797	1341083	14831063	16272108	17792152	19492218	21392302	23492416	25792530	28292644	30992758	33892872	36892986	39993100	43193214	46493328	49893442	53293556	56793670	60193784	63593898	67094012	70494126	73994240	77394354	80894468	84294582	87794696	91194810	94694924	98195038	101595152	105095266	108595380	111995494	115495608	118995722	122495836	125995950	129496064	132996178	136496292	139996406	143496520	146996634	150496748	153996862	157496976	160997090	164497204	167997318	171497432	174997546	178497660	181997774	185497888	188998002	192498116	195998230	199498344	202998458	206498572	209998686	213498800	216998914	220499028	223999142	227499256	230999370	234499484	237999598	241499712	244999826	248499940	251999054	255499168	258999282	262499396	265999510	269499624	272999738	276499852	279999966	283499080	286999194	290499308	293999422	297499536	300999650	304499764	307999878	311499992	314999006	318499120	321999234	325499348	328999462	332499576	335999690	339499804	342999918	346499032	349999146	353499260	356999374	360499488	363999602	367499716	370999830	374499944	377999058	381499172	384999286	388499400	391999514	395499628	398999742	402499856	405999970	409499084	412999198	416499312	419999426	423499540	426999654	430499768	433999882	437499996	440999000	444499114	447999228	451499342	454999456	458499570	461999684	465499798	468999912	472499026	475999140	479499254	482999368	486499482	489999596	493499710	496999824	500499938	503999052	507499166	510999280	514499394	517999508	521499622	524999736	528499850	531999964	535499078	538999192	542499306	545999420	549499534	552999648	556499762	559999876	563499990	566999004	570499118	573999232	577499346	580999460	584499574	587999688	591499802	594999916	598499030	601999144	605499258	608999372	612499486	615999600	619499714	622999828	626499942	629999056	633499170	636999284	640499398	643999512	647499626	650999740	654499854	657999968	661499082	664999196	668499310	671999424	675499538	678999652	682499766	685999880	689499994	692999008	696499122	699999236	703499350	706999464	710499578	713999692	717499806	720999920	724499034	727999148	731499262	734999376	738499490	741999604	745499718	748999832	752499946	755999060	759499174	762999288	766499402	769999516	773499630	776999744	780499858	783999972	787499086	790999200	794499314	797999428	801499542
Cumulative Sums: Total		10266	23732	32156	22552	16281	12449	8117	6253	5619	4249	2901	2363	2383	2066	1706	1443	1366	1517	1229	1011	533	457	336	453	282	306	264	211	212	255	164	32	20	13	3	15	163537	195																																																																																																																																																																																																														

All Dives



Distribution of Dives by Depth and Bottom Time

Navy Dives

Scuba

[illegible]

Cumulative Sums: Scuba

[illegible]

Cumulative Sums: Surface Supplied

[illegible]

Cumulative Sums: Total

21 - 25	1964	5430	9832	14009	15353	16296	17065	17755	18284	18720	19256	19672	20052	20385	20660	20870	21109	21387	21645	21880	22113	22346	22568	22780	22991	23192	23393	23593	23793	23993	24193	24393	24593	24793	24993	25193	25393	25593	25793	25993	26193	26393	26593	26793	26993	27193	27393	27593	27793	27993	28193	28393	28593	28793	28993	29193	29393	29593	29793	29993	30193	30393	30593	30793	30993	31193	31393	31593	31793	31993	32193	32393	32593	32793	32993	33193	33393	33593	33793	33993	34193	34393	34593	34793	34993	35193	35393	35593	35793	35993	36193	36393	36593	36793	36993	37193	37393	37593	37793	37993	38193	38393	38593	38793	38993	39193	39393	39593	39793	39993	40193	40393	40593	40793	40993	41193	41393	41593	41793	41993	42193	42393	42593	42793	42993	43193	43393	43593	43793	43993	44193	44393	44593	44793	44993	45193	45393	45593	45793	45993	46193	46393	46593	46793	46993	47193	47393	47593	47793	47993	48193	48393	48593	48793	48993	49193	49393	49593	49793	49993	50193	50393	50593	50793	50993	51193	51393	51593	51793	51993	52193	52393	52593	52793	52993	53193	53393	53593	53793	53993	54193	54393	54593	54793	54993	55193	55393	55593	55793	55993	56193	56393	56593	56793	56993	57193	57393	57593	57793	57993	58193	58393	58593	58793	58993	59193	59393	59593	59793	59993	60193	60393	60593	60793	60993	61193	61393	61593	61793	61993	62193	62393	62593	62793	62993	63193	63393	63593	63793	63993	64193	64393	64593	64793	64993	65193	65393	65593	65793	65993	66193	66393	66593	66793	66993	67193	67393	67593	67793	67993	68193	68393	68593	68793	68993	69193	69393	69593	69793	69993	70193	70393	70593	70793	70993	71193	71393	71593	71793	71993	72193	72393	72593	72793	72993	73193	73393	73593	73793	73993	74193	74393	74593	74793	74993	75193	75393	75593	75793	75993	76193	76393	76593	76793	76993	77193	77393	77593	77793	77993	78193	78393	78593	78793	78993	79193	79393	79593	79793	79993	80193	80393	80593	80793	80993	81193	81393	81593	81793	81993	82193	82393	82593	82793	82993	83193	83393	83593	83793	83993	84193	84393	84593	84793	84993	85193	85393	85593	85793	85993	86193	86393	86593	86793	86993	87193	87393	87593	87793	87993	88193	88393	88593	88793	88993	89193	89393	89593	89793	89993	90193	90393	90593	90793	90993	91193	91393	91593	91793	91993	92193	92393	92593	92793	92993	93193	93393	93593	93793	93993	94193	94393	94593	94793	94993	95193	95393	95593	95793	95993	96193	96393	96593	96793	96993	97193	97393	97593	97793	97993	98193	98393	98593	98793	98993	99193	99393	99593	99793	99993
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Figure A2

Navy Dives

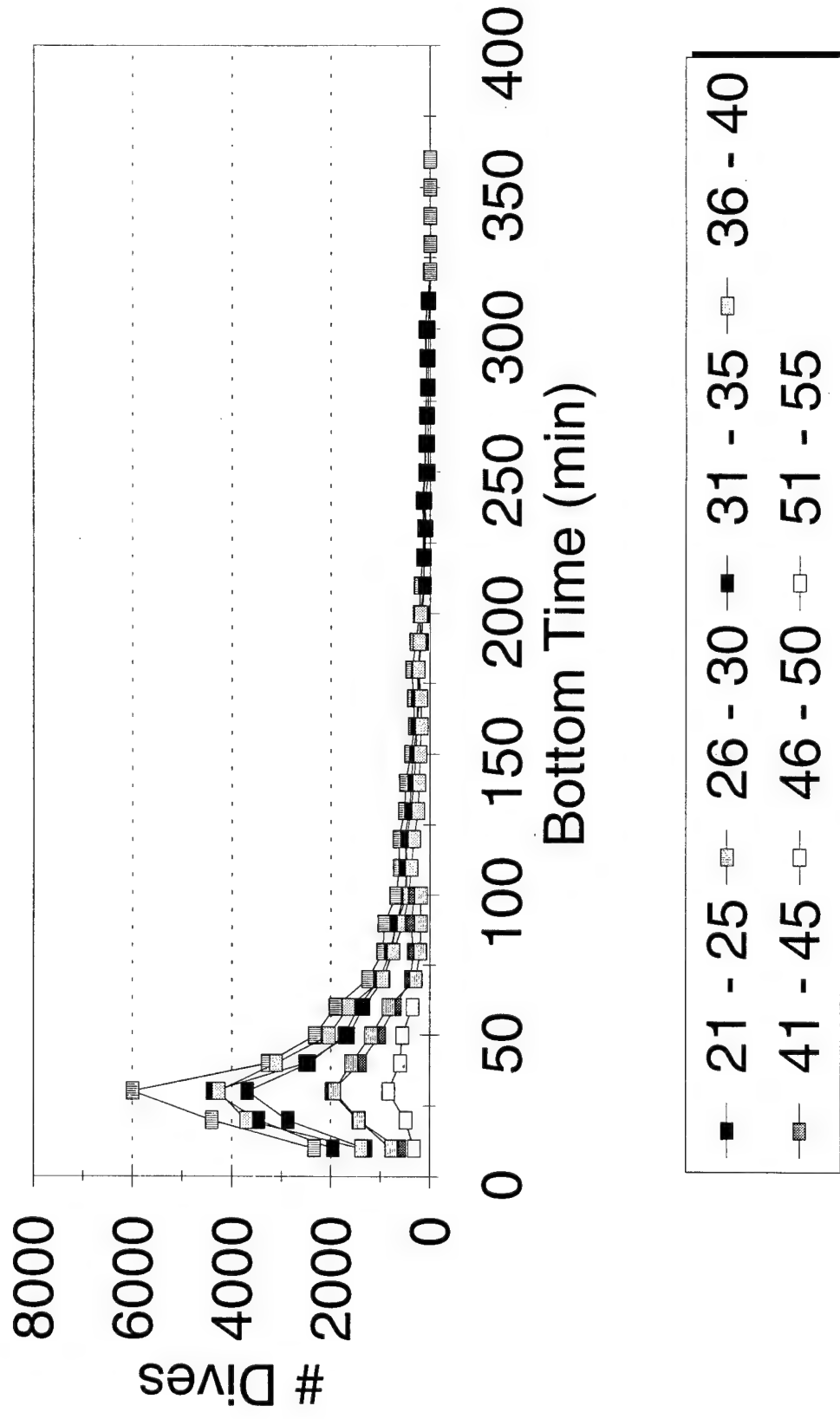


Table A3

Distribution of Dives by Depth and Bottom Time

Civilian Dives

Scuba

B.T. →	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100-110	111-120	121-130	131-140	141-150	151-160	161-170	171-180	181-190	191-200	201-210	211-220	221-230	231-240	241-250	251-260	261-270	271-280	281-290	291-300	301-310	311-320	321-330	331-340	341-350	351-360	Totals	# Bayc	No-D Li
21-25	51	148	192	155	147	90	108	66	56	45	23	34	19	23	16	8	4	8	2	1	1	0	5	8	9	3	0	0	0	0	0	0	0	0	0	0	0	1513	0
26-30	103	354	320	320	266	279	212	156	54	58	65	60	34	13	23	13	15	9	9	9	14	0	6	9	3	13	0	0	0	0	0	0	0	0	0	0	0	1278	0
31-35	28	147	175	142	134	160	101	86	90	45	19	49	30	14	7	12	14	9	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2153	0	
36-40	21	104	124	105	102	118	187	133	102	62	48	37	43	33	23	4	9	5	6	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	732	1	
41-45	27	115	128	108	108	80	40	28	41	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1608	8		
46-50	14	81	151	167	197	192	200	174	211	203	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	305	0		
51-55	10	64	48	45	62	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10100	9	
Totals	297	1143	1434	1290	1239	1062	933	711	643	450	156	185	153	104	59	45	40	37	24	31	15	0	11	18	3	16	0	0	0	0	0	0	0	0	0	0	0	0	

Cumulative Sums: Scuba

21-25	51	199	391	546	693	783	891	957	1013	1058	1081	1115	1134	1157	1173	1179	1183	1191	1195	1195	1200	1200	1209	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212
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Surface Supplied

B.T. →	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100-110	111-120	121-130	131-140	141-150	151-160	161-170	171-180	181-190	191-200	201-210	211-220	221-230	231-240	241-250	251-260	261-270	271-280	281-290	291-300	301-310	311-320	321-330	331-340	341-350	351-360	Total	# Bayc	No-D Li
21-25	88	219	341	330	281	228	190	170	184	144	97	95	86	69	47	32	20	28	29	12	9	6	2	3	13	3	4	3	2	0	5	2	0	0	0	0	2719	0	
26-30	207	681	1425	1221	995	680	441	429	359	255	180	130	83	67	63	44	34	29	29	14	10	6	7	3	6	5	3	2	0	2	4	7	0	0	0	5109	0		
31-35	83	380	577	638	476	397	400	274	271	206	182	165	170	128	136	99	110	132	102	64	26	9	14	9	6	13	3	2	0	0	0	0	0	0	0	7604	9		
36-40	97	445	638	638	476	397	400	274	271	206	182	165	170	128	136	99	110	132	102	64	26	9	14	9	6	13	3	2	0	0	0	0	0	0	0	1335	12		
41-45	58	229	461	657	831	954	1053	1136	1239	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331		
46-50	26	158	312	368	336	241	212	185	201	164	3	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	186	0		
51-55	4	28	44	72	117	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196		
Totals	583	2389	3865	3917	3168	2359	2047	1576	1429	1127	740	708	619	516	418	355	343	365	309	192	51	31	22	20	22	20	13	11	6	10	16	5	1	0	0	0	27401	32	

Cumulative Sums: Surface Supplied

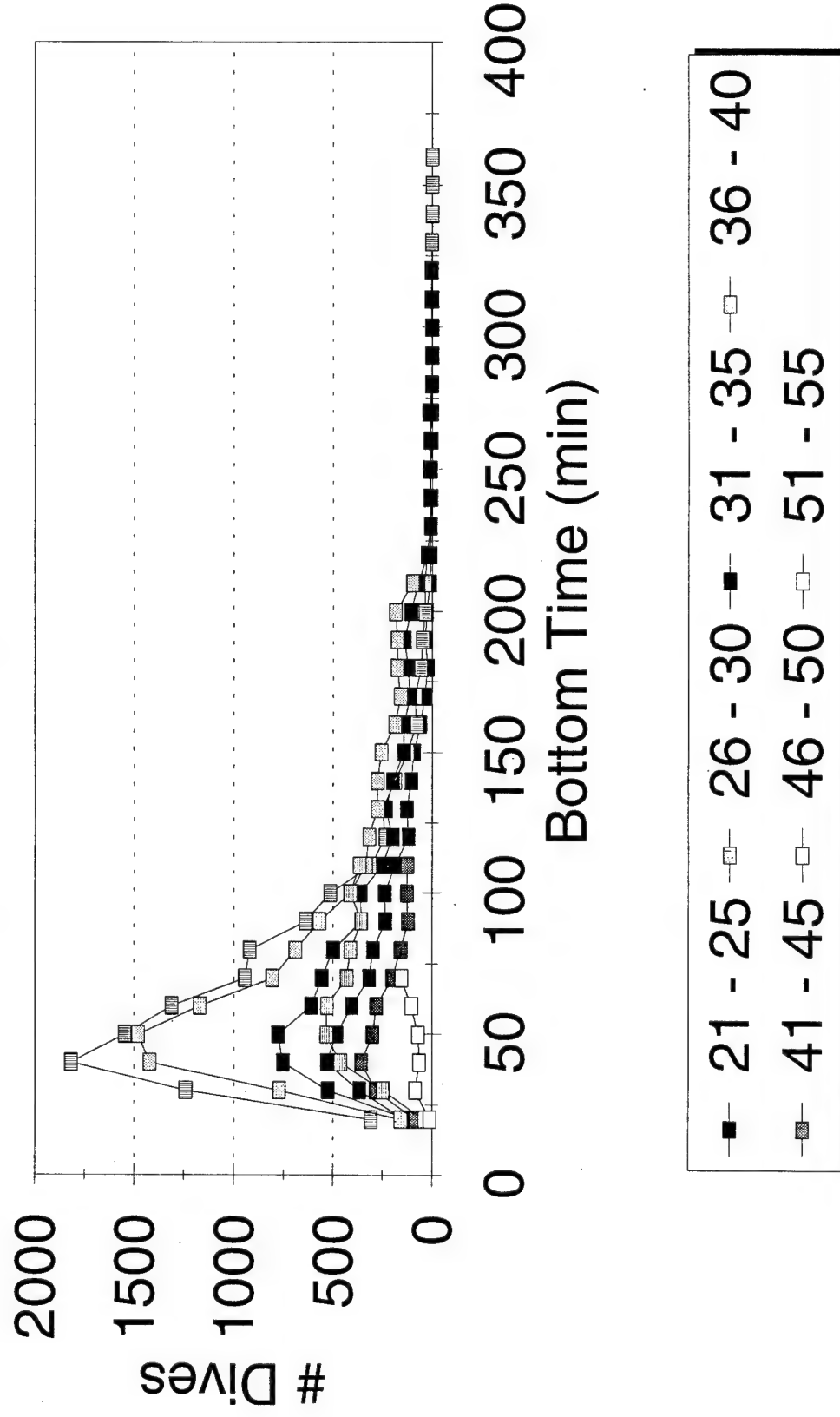
21-25	88	307	648	978	1239	1467	1657	1827	2011	2155	2252	2347	2433	2501	2546	2578	2598	2628	2654	2666	2675	2684	2688	2699	2702	2703	2707	2710	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712	2712
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Total

B.T. →	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100-110	111-120	121-130	131-140	141-150	151-160	161-170	171-180	181-190	191-200	201-210	211-220	221-230	231-240	241-250	251-260	261-270	271-280	281-290	291-300	301-310	311-320	321-330	331-340	341-350	351-360	Total	# Bayc	No-D Li
21-25	139	367	533	485	408	318	298	236	240	189	120	129	105	91	81	66	57	36	24	38	28	10	7	12	13	4	4	3	2	0	5	2	0	0	0	0	2902	0	
26-30	310	1555	1820	1551	1315	946	820	641	515	309	238	250	190	127	80	66	47	36	29	29	14	10	6	7	13	4	4	3	2	0	2	4	7	0	0	0	7604	0	
31-35	111	527	752	780	610	557	501	360	361	251	201	234	200	147	143	111	124	141	106	71	26	9	14	9	1	0	1	0	1	0	0	0	1	0	0	0	9657	9	
36-40	112	525	752	780	610	557	501	360	361	251	201	234	200	147	143	111	124	141	106	71	26	9	14	9	1	0	1	0	1	0	0	0	1	0	0	0	9657	9	
41-45	185	248	360	392	283	230	199	159	128	101	78	278	257	190	161	177	176	186	105	2	3	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	3422	18	
46-50	249	463	532	535	429	449	463	353	323	243	192	126	77	51	30	16	10	10	10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	503	0	
51-55	86	66	66	73	107	157	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	
Totals	180	3532	5419	5207	4421	2960	2287	2072	1577	896	893	772	620	475	400	383	402	363	223	86	31	33	38	25	36	13	11	6	10	16	1	0	1	0	0	37601	41		

Figure A3

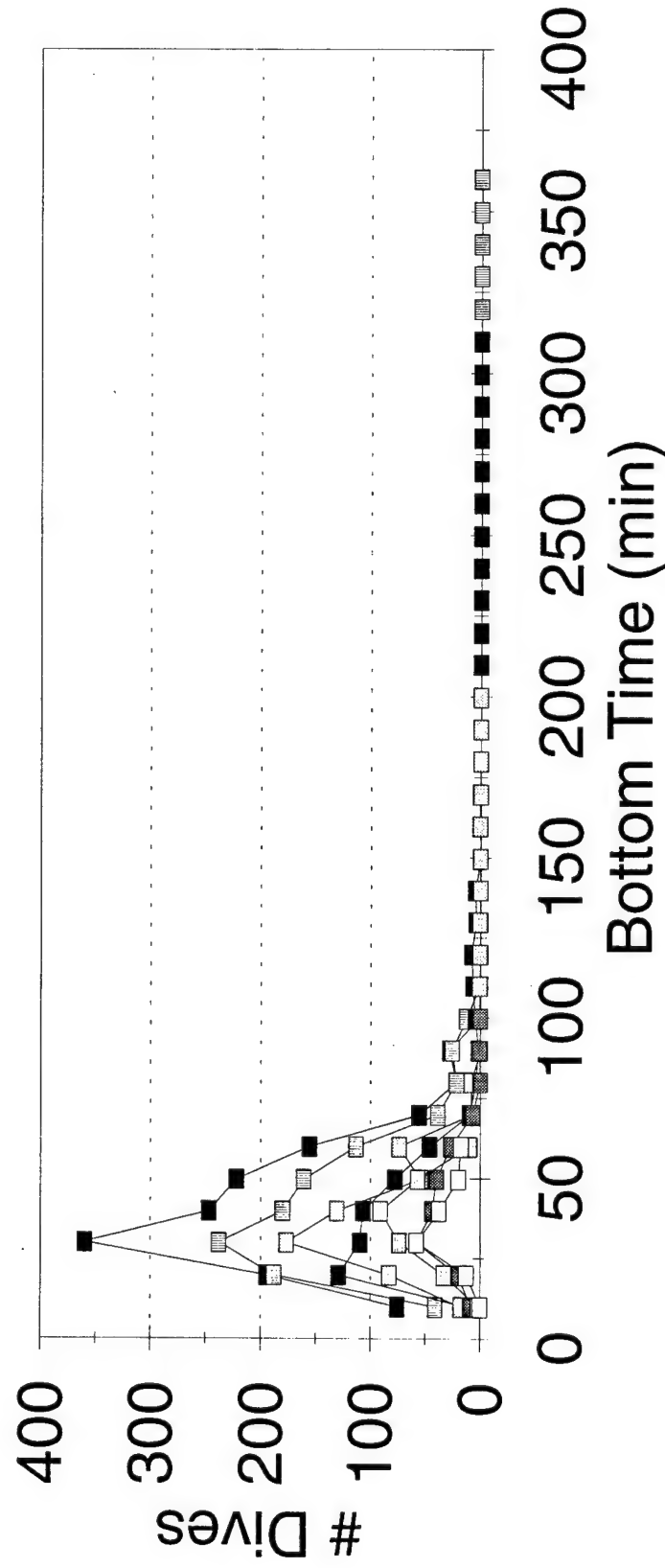
Civilian Dives



[illegible]

Figure A4

Marine Dives



Reserves Dives

Scuba

[illegible]

21-25	99	371	843	1100
26-30	138	463	949	1197

[illegible]

B.T.	0-10	11-20	21-30
Deaths			

Cumulative Sums: Surface Supplied	
21-25	31
26-30	84
31-35	162
36-40	27
41-45	13
46-50	47
51-55	163
56-60	439
61-65	546
66-70	79
71-75	42
76-80	34
81-85	15
86-90	9
91-95	16
96-100	3
Totals	1518

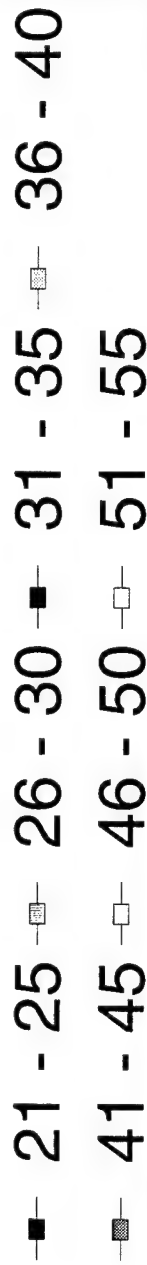
21-25	31	115	277	324	337	350
26-30	40	182	352	417	444	456

[illegible]

21-25	130	486	1120	1424
26-30	178	645	1301	1514

[illegible]

Reserves Dives



APPENDIX B

Part I. Summary of Cases

Code

Purpose of Dive

SW = SPECWAR
SH = Ship Husbandry
TN = Training
UC = Underwater Construction
SR = Search
SS = Security Swim
EO = EOD
SV = Salvage
RQ = Requal
IS = Inspection

Rig

SO = Open circuit SCUBA
SS = Surface-supplied

NMRI Diagnosis

Class

1 = Definitely Decompression Illness
2 = Definitely not Decompression Illness
3 = Uncertain if Decompression Illness or not

SubClass

A = Decompression Sickness
B = Arterial Gas Embolism
C = Decompression Sickness or Arterial Gas Embolism
N = Not applicable

Naval Safety Center Diagnosis (SAFE Dx)

1 = Type I Decompression Sickness
2 = Type II Decompression Sickness
3 = Arterial Gas Embolism

Service

N = Navy
M = Marine
C = Civilian

Part II. Case Descriptions

Narratives exactly as received from NSC; "(sic)" used to denote obvious and/or distracting errors
Cases with bottom times longer than the USN93 limit are indicated with an asterisk.

Part I. Summary of Cases

Case #	Day	Month	Year	Purpose	Rig	Depth	Bottom Time	NMRI Diagnosis		SAFE Dx	Service
								Class	Subclass		
1	3	2	90	SW	SO	50	52	3	N	2	N
2	3	2	90	SW	SO	50	52	3	N	2	N
3*	2	3	90	SW	SO	30	397	3	N	2	N
4*	16	3	90	SW	SO	30	397	1	A	2	N
5	21	3	90	TN	SS	52	13	1	A	2	N
6	18	4	90	TN	SO	45	46	1	A	1	M
7	9	6	90	UC	SS	52	46	1	A	1	N
8	7	8	90	SH	SO	40	74	1	A	2	C
9	29	8	90	SW	SO	29	135	1	A	2	N
10	23	10	90	SS	SO	36	30	3	N	2	N
11*	6	11	90	SH	SS	40	189	1	A	2	N
12	5	12	90	SH	SS	26	50	3	N	2	N
13	15	1	91	SR	SS	55	29	2	N	2	N
14	27	1	91	SH	SS	27	17	1	C	2	N
15	1	2	91	SH	SS	30	30	1	C	2	N
16	11	2	91	SH	SS	37	134	1	A	1	N
17	5	4	91	SH	SO	35	76	1	C	2	N
18	16	2	93	SH	SS	31	87	2	N	2	N
19	23	3	93	SH	SS	41	99	2	N	2	N
20	29	3	93	SH	SS	42	97	3	N	2	N
21*	21	7	93	SW	SO	33	278	1	A	1	N
22	9	8	93	SH	SS	25	140	3	N	2	N
23	16	3	94	RC	SO	30	45	1	A	2	N
24	21	4	94	SH	SS	22	91	3	N	2	N
25	27	5	94	SH	SS	38	91	1	C	2	C
26	12	7	94	SW	SO	28	265	2	N	2	N
27	8	8	94	SH	SO	45	15	3	N	2	N
28	8	8	94	SH	SS	36	113	1	A	2	N
29	17	8	94	SR	SO	27	73	3	N	2	N
30	29	1	90	TN	SO	22	29	1	C	3	N
31	14	2	90	SW	SO	40	121	1	C	3	N
32	24	4	90	TN	SO	24	40	1	A	3	N
33	21	5	90	SW	SO	36	50	2	N	3	N
34	21	5	90	SW	SO	36	50	3	N	3	N
35	19	7	90	SR	SS	26	61	1	C	3	N
36*	21	8	90	SH	SS	37	176	1	A	3	N
37	29	10	90	SH	SS	25	44	1	C	3	N
38	12	11	90	SV	SS	33	134	3	N	3	N
39*	9	1	91	SH	SS	34	191	3	N	3	N
40	4	4	91	SR	SO	40	3	2	N	3	N
41	30	5	91	SV	SO	35	52	1	C	3	N
42	30	5	91	SV	SO	35	52	3	N	3	N
43	11	6	91	EO	SO	50	40	1	A	2	N
44	16	7	91	SH	SS	26	25	1	C	3	N
45	1	8	91	TN	SS	29	22	3	N	3	N
46	5	9	91	SW	SO	29	74	1	C	3	N
47	7	10	91	SH	SS	35	115	3	N	3	N
48	6	11	91	EO	SO	45	23	1	B	3	N
49	16	2	93	IS	SO	47	57	1	C	3	C
50	25	2	93	SS	SO	40	20	1	B	3	N
51	16	3	93	RC	SO	42	20	1	B	3	N
52	21	3	93	SV	SS	52	58	1	C	3	N
53	27	7	93	SR	SO	22	25	2	N	3	N
54	31	8	93	SH	SS	28	37	1	B	3	N
55	13	10	93	SR	SS	35	43	1	A	3	N
56	18	11	93	IS	SO	23	44	1	A	3	N
57	28	1	94	EO	SO	37	20	3	N	3	N
58	23	2	94	EO	SO	40	20	1	B	3	N
59	25	3	92	SW	SO	25	40	1	A	3	N
60	30	8	92	SH	SS	21	63	1	A	2	N

Part II. Case Descriptions

Case 1

This 27 year old male spec war diver made a no "D" dive using SCUBA. The dive was on air to 50 fsw for :52. Upon surfacing the diver experienced extreme fatigue following submarine lock out. The diver was examined and no other deficit was found. He was compressed to 60 fsw and had complete relief :55 at depth. The diver was treated on a TT 6 with one extrnsion (*sic*) at 60 fsw. No meds were used, final diagnosis was DCS II, treated by DMO, 2 days loss of work and 28 days restricted from diving.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 2

This 25 year old male Spec War diver made a no "D" dive using SCUBA. The dive was on air to 50 fsw for :52. Upon surfacing the diver experienced extreme fatigue following submarine lock out. The diver was examined and no other deficit was found. He was compressed to 60 fsw and had complete relief :55 at depth. The diver was treated on a TT 6 with one extension at 60 fsw. No meds were used, final diagnosis was DCS II, treated by DMO, 2 days loss of work and 28 days restricted from diving.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 3*

This 40 year old male Spec War diver made an SDV dive using open circuit SCUBA. The dive was to 30 fsw for 6 hours and 37 mins. The dive was reported as a no "D" dive. According to standard air tables the dive was 40 for 480 exceptional exposure because the max time of the repetative (*sic*) group designator table was exceeded. After a restless night the diver reported to work in the morning. Physical discomfort was reported to the diving supervisor. A neurological exam was normal but neuropsych screening was borderline. The diver was compressed to 60 fsw and treated on a treatment table 6. No meds were used. No days loss of work, 4 days restricted from diving, final diag. DCS Type Type (*sic*) II by DMO. The other diver on this dive had DCS II and treated (*sic*).

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 4*

This 41 year old male Spec War diver make (*sic*) an SDV dive using open circuit SCUBA. The dive was to 30 fsw for 6 hrs and 37 mins. The dive was reported as a no "D" dive. According to standard air tables the dive was 40 for 480 exceptional exposure because the max time of the repetitive group designator table was exceeded. The following morning the diver reported a restless evening and a physical discomfort to the Div Sup. A neuro revealed decreased light touch and pin prick sensation over right lateral thigh. The diver was compressed to 60 fsw and treated on a TT 6. No meds were used, no loss days from work, 4 days restricted from diving. Final diag. DCS II by DMO. The other diver on this dive had DCS II and treated (*sic*).

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 5

This 29 year old Navy male 1st class diving student made a training dive using Mark XII SSDS air. The dive was to 52 fsw for :13 min bottom time no "D". Forty five minutes after surfacing he reported pain in the left shoulder and elbow. A neuro also revealed nystagmus in the right eye. The diver was compressed to 60 fsw and treated on a TT 6 with 2 extensions at 60 fsw. Complete relief was noted at 8 mins. into 2nd O2 period at 60 fsw. Medications used: 1000 cc of normal saline. Two days loss of work and 14 days restricted from diving. Final diagnosis DCS Type 2 by MDV.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 6

This 20 year old male Marine Corps SCUBA student made an open water SCUBA training dive. The dive was to 45 fsw for :46 min no "D". Nine hours after surfacing the diver complained to the supervisor of pain in the left knee. A neuro was conducted and neurological deficit was found. The diver was compressed to 60 fsw and treated on a TT 6. Complete relief occurred during the 4th O2 period at 60 fsw. No drugs were used, no days loss from work and 28 days restricted from diving. Final diagnosis was DCS Type one by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type I Decompression Sickness

Case 7

This 21 year old male 2nd class diver made an underwater const. ops dive in open water using MK XII, air, swimmers configuration. The depth was to 52 fsw for 46 min no "D". Approx. five minutes after surfacing the diver noted a dull pain behind right kneecap. A neuro was completed by a DMT with no other findings. The same pain waxed and waned over the next 50 minutes. The diver was compressed to 60 fsw, complete relief was obtained upon reaching treatment depth. Treated on a treatment table 5, no days loss of work, 5 days restricted from diving, no meds used, final diagnosis DCS I by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type I Decompression Sickness

Case 8

This 26 year old male ship yard diver made a ships husbandry dive using open circuit SCUBA. The dive was to 40 fsw for 19 minutes no "D". The previous day this diver made a no "D" dive to 40 fsw for 74 minutes bottom time. During ascent of this dive he noticed pain in his right hip. This pain was not reported. The next dive he made the 40 fsw for :19 dive. He noticed the pain improved on the bottom of this dive. On ascent this pain increased. Upon surfacing he was taken to the DMO and compressed to 60 fsw and had complete relief upon reaching treatment depth. Due to the location of the pain he was treated on a TT 6 with one extension at 60 fsw. No meds were used, one day loss of work, 14 days restricted from diving, final diagnosis was DCS II by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 9

This 24 year old male SEAL made an SDV training dive with SDV air system and full face mask. The gas media was air. The dive was to 29 fsw for 2:15 no "D". :45 after surfacing the diver reported numbness to left nostril and left quadriceps. He was compressed to 60 fsw and had complete relief upon reaching treatment depth. No meds were used, no days loss of work, 14 days restricted from diving. Final diagnosis was Type 2 DCS by DMO. Suspect circulation impaired by tightness of equipment.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 10

This 24 years old male SCUBA diver made a security swim using open circuit SCUBA. The dive was to 36 fsw or (*sic*) :30 BT. Approx 3 hours after the dive this diver became dizzy, felt nauseated and had a painful left ear. A neuro was performed by a DMO and DCS Type II was diagnosed. The diver was transported to a recompression chamber and compressed to 60 fsw on O2. Complete relief was obtained during the 1st O2 period. He was treated on a TT 6, Meclizine was given, no days loss of work, 30 days restricted from diving.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 11*

This 23 year old 2nd class diver made a ships husbandry using MK 21 air. The dive was to 40 fsw for 180 minutes no "D". Approx one hour after surfacing the diver noticed pain and a slight numbness in his left forearm. The diver did not report these symptoms until five hours later. He was compressed to 60 fsw on O2 and had 1st relief on descent at 30 fsw. Complete relief was obtained 33 minutes into the treatment. A TT 6 was completed, no meds were used, no days loss of work and 14 days restricted from diving. Final diagnosis DCS Type II by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 12

This 19 year old 2nd class diver made a ships husbandry dive using MK 21 air. The dive was to 26 fsw for :50. No "D". Upon surfacing this diver reported that his foot was numb. A neuro was completed with no significant findings. He was transported to a chamber and treated on a TT 6. First relief was noted :13 into the treatment and complete relief at :29. No meds were used, no days loss of work and 21 days restricted from diving. Final diagnosis was DCS II by DMO. Phoncon to his master diver, who was TAD at the time of the dive and the treatment, reported that this diver was very cold and tired and wore an ill fitting wet suit. He feels that the DCS II diagnosis was highly unlikely due to the dive profile.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 13

This 33 year old Navy Saturation Diver made a search dive using MK 21. The dive was to 55 fsw for :29 BT no "D". Upon surfacing the diver noticed numbness and tingling in the top of his left foot. The diver also reported that his boot was too tight. MDV and DMT performed thorough neurological examination. No other findings were noted. DCS could not be ruled out so the diver was compressed to 60 fsw on O2. Partial relief of symptoms were noted after :03 at depth and complete relief was obtained after :14. No meds were used, no days loss of work and 14 days restricted from diving. Final diagnosis DCS Type II by MDV and DMT.

NMRI Diagnosis: Definitely not decompression illness

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 14

This 32 year old Navy HeO2 diving officer made a ships husbandry dive using MK-1 air. The dive was to 27 fsw for :17 BT. :67 after surfacing the diver complained of left arm tremors, numbness, and weakness. Deamethasone (*sic*) 10 MGM was given during medivac to the recompression chamber. He was compressed to 60 fsw on O2. First relief was obtained upon reaching depth and complete relief during the first O2 breathing period. He was treated on a TT six. Three days loss of work. 28 days refricted (*sic*) from diving. Final diagnosis DCS II.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 15

This 28 year old Navy 1st class diver made a ships husbandry dive using MK-1 air. The dive was to 30 fsw for :30 no "D". Approx 15 min after surfacing the diver felt slight disorientation but did not report this until 40 mins later. A neuro exam revealed vestibular imbalance and lower extremity weakness. He was placed on O2 and transported to recompression chamber.

Compression was to 60 fsw on O2. Complete relief was obtained 22 minutes into the treatment.

A TT 6 was completed. No meds were used, one day loss of work and 7 days restricted from diving. Final diagnosis was DCS Type II by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 16

This 20 year old male 2nd class diver made a ships husbandry dive using ESDS AGA. The dive was to 37 fsw for 2:14 no "D". Approx. four hours after the dive the diver (*sic*) the diver complained of pain in the right thigh. No type two symptoms were noted. The diver was compressed to 60 fsw and had first relief eight minutes into the treatment. Complete relief was noted twenty one minutes later. A TT 6 was completed. No meds were used, no days loss of work, 7 days restricted from diving. Final diagnosis, DCS 1 by MDV.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type I Decompression Sickness

Case 17

This 30 year old 1st class diver made a ships husbandry dive using open circuit SCUBA. The dive was to 35 fsw for 1:16. Thirty minutes after surfacing the diver complained that his left hand was not feeling as it should. A neuro exam showed numbness of the left thumb, index, and middle finger. He was compressed to 60 fsw on O2. First relief was noted upon reaching treatment depth and complete relief :09 into the treatment. A TT 6 was completed. No meds were used, no days loss of work and 14 days restricted from diving. Final diagnosis was DCS II by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 18

This 22 year old male 2nd class diver made a ships's (*sic*) husbandry dive using MK 21. The dive was to 31 fsw for 8M (*sic*) mins. Three weeks after dive this diver reported severe headaches, dizziness, and memory loss. Neuro exam conducted by DMO and MDV with no neuro deficit noted. Referred member to Naval Hospital for full neurological testing and decision made to treat member on htperbaric (*sic*) oxygen. Recompressed to 60 fsw with no relief noted during treatment. A TT6 was completed. No meds were used. 17 days loss of work and 17 days restricted from diving.

NMRI Diagnosis: Definitely not decompression illness

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 19

This 26 year old male first class diver made a MK-21 dive to 41 fsw for 99 mins while inspecting patches for leaks during salvage operations on a ship. 4 hrs 50 mins after surfacing diver complained of numbness to left great toe. Neuro exam conducted with no other symptoms noted. Diver recompressed to 60 fsw and treated on a TT-6 for DCS type II. Diver had complete relief 4 hrs 37 mins into the treatment. No meds were used. No days loss of work and 14 days restricted from diving.

NMRI Diagnosis: Definitely not decompression illness

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 20

This 21 year old male second class diver made a ship's (*sic*) husbandry dive using ESDS to a maximum depth of 42 fsw for 1 hr 37 mins. Approximately 10 hrs after surfacing diver reported radiating pain in his left leg and "something not being quite right". Neuro exam revealed numbness on the left leg from the knee to the toes and weakness in the lower extremity of the left leg. Diver recompressed to 60 fsw and treated on TT6 for DCS Type II. Complete relief noted 5 hrs 4 mins into treatment. No meds were used. 1 day loss of work and 28 days restricted from diving.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 21*

This 29 year old male SEAL Diver made a SCUBA hookah dive from a Dry Deck Shelter (DDS) to 33 fsw for 4 hrs 38 mins. During drain down at 20 fsw diver noticed pain in his lower back. Drain depth was increased to 30 fsw for duration with no change noticed by diver. Upon surfacing a neuro exam was conducted with no other symptoms noted. Diver was recompressed to 60 fsw and treated on TT5 for DCS type I. Diver had complete relief 1 min into the treatment. No meds were used. No days loss of work and 2 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type I Decompression Sickness

Case 22

This 22 year old male second class diver made a dive to perform a shaft wrap using MK 21. His dive profile was 25 fsw for 2 hrs 20 mins. While removing his gear on the surface the diver noticed that his right foot seemed to drop and he had decreased sensation over the dorsum of the right foot. Neuro exam was conducted with no other neurological symptoms noted. Diver recompressed (*sic*) to 60 fsw and treated on a TT-6 for DCS type II. Diver had some relief 25 mins into the treatment but remained unchanged during the rest of the treatment. 1000 ML of Ringers Lactate administered IV. One day loss of work and 21 days restricted from diving.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 23

This 22 year old male second class diver made a recreational dive using open circuit scuba to 30 fsw for 45 mins. 2 hours after surfacing diver noticed intermittent tingling radiating from his right shoulder to his hand. Diver noticed right arm feeling numb the following morning and reported symptoms. Neuro exam revealed marked weakness to right arm and numbness of right shoulder to hand. Diver recompressed to 60 fsw and treated on TT 6 for DCS type II. No drugs were used. Diver had complete relief 3 hours and 14 mins into the treatment. 2 days loss of work and 30 days restricted (*sic*) from diving.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 24

This 38 year old male Master Diver made a ships husbandry dive using MK 21 to a depth of 22 fsw for 1 hr 31 mins. Diver surfaced with soreness in his right arm and feeling tired. Diver did not report these symptoms for two days. Neuro exam revealed right arm pain and soreness. Diver also was very fatigued. Diver recompressed to 60 fsw and treated on TT 6 for DCS Type II. No drugs were used. Diver had complete relief of symptoms 2 hrs 45 mins into the treatment. No days loss of work and 30 days restricted from diving.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 25

This 36 year old male civilian rigger diver made a ship's husbandry dive to 38 fsw for 1 hr 31 mins using MK 21. Upon surfacing the diver noticed the tip of his fifth digit on his left hand felt numb. Diver sup felt it may have been caused by a mechanical injury. After the diver had showered and warmed up he noticed the numbness had spread to his next finger. Diver transported to nearest chamber and recompressed to 60 fsw and treated on TT 6 for DCS Type II. No drugs were used. Diver had complete relief 23 mins into the treatment. No days loss of work and 14 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 26

This 23 year old male SEAL Diver made a SCUBA dive while conducting SDV diving operations. During the dive the diver reported that his wet suit was very tight and restrictive. Upon completion of his dive the diver noticed a patch of numbness on his left forearm. Neuro exam revealed no other symptoms. Diver was recompressed to 60 fsw and treated on TT 6 for possible DCS Type II. Diver had no relief of symptoms during the treatment. No days loss of work and 5 days restricted from diving.

NMRI Diagnosis: Definitely not decompression illness

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 27

This 24 year old male Navy SCUBA diver made a ship's husbandry dive to 45 fsw for 15 mins using open circuit SCUBA. Appox 1 and 1/2 hrs after surfacing diver complained of feeling "heavy" and tired. Diver was recompressed to 60 fsw and treated on TT 6 for DCS Type II. Diver had complete relief of symptoms 50 mins into the treatment. 4 Liters Ringer's Lactate IV was used. No days loss of work and 30 days restricted from diving.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 28

This 28 year old male First Class Diver made a ship's husbandry dive to 36 fsw for 1 hr 53 mins using MK -20. Appox 1 hr after surfacing diver developed a headache and fatigue. The next morning he reported his symptoms to the Diving Supervisor. Diver was recompressed to 60 fsw and treated on TT 6 for DCS type II. Diver had complete relief of symptoms 33 mins into the treatment. No drugs were used. No days loss of work and 30 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 29

This 30 year old male USMC combat diver made a compass/navigation dive to 27 fsw for 1 hr 13 mins using open circuit SCUBA. Approx 30 mins after surfacing diver complained of tingling in his right forearm. Diver recompressed to 60 fsw and treated on TT6 for DCS type II. Diver had complete relief of symptoms 1 hr 54 mins into the treatment. No drugs were used. No days loss of work and 28 days restricted from diving.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 30

This 22 year old female student officer made a training dive using SCUBA. The dive was to 29 fsw for :29 min No D. Approx. upon surfacing she complained of a mild headache. A neuro was conducted by a DMO and no deficits were found. Oral motran (*sic*) was given at this time. Approx. one hour later she reported headache worsening, nauseous (*sic*), lightheaded and “not feeling right”. A second neuro showed: pronounced weakness in left side of neck muscles, weakness in left extremities and degraded neural responses in left foot. Compressed to 165 fsw with 1st relief at 04: After leaving the surface. A TT 6A was completed with one extension at 60 fsw. An I.V. of Ringers Lactate was administered during treatment. The following AM left leg weakness was found on follow up neuro. A TT 6 was conducted with 1st relief at 1:29. A neuro on the following day still showed left leg weakness. A TT 6 was administered with complete relief at :28. Three days loss of work, 28 days restricted from diving, final diagnosis AGE.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 31

This 20 year old male basic combat swimmer made an SDV training dive using SCUBA. The dive was to 40 fsw for 2 hrs and :01 min. Instructors observed him having difficulty maintaining depth control of the SDV. Upon surfacing the diver was unresponsive and sluggish (*sic*). The diving med tech on scene conducted a neuro and found upper extremity weakness. He was placed on surface O2 and transported to the chamber. He was recompressed (*sic*) to 165 fsw where another neuro by a DMO showed upper extremity weakness, loss of coordination, proprioception and positive Babinski of right foot. Complete relief was obtained within :30 mins at 165 fsw. He was treated on a TT 6AM (*sic*), no meds were used, one day loss of work, 60 days restricted from diving, final diagnosis AGE.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 32

This 20 year old male Navy diving student made a training dive using open circuit SCUBA. The dive was to 24 fsw for :40 mins no "D". He surfaced complaining of feeling light headed. A neurological exam revealed no deficits. Approx. :30 minutes later he complained of pain in the left elbow. A neurological exam again showed no neurological deficits and the diver returned to the dive station. Approx. :20 to :30 the diver complained of tingling in left hand and fingers. Again the neuro was normal. AGE could not be ruled out so the diver was compressed to 165 fsw and treated on a TT 6A. Relief was obtained at :05 mins at treatment depth. No meds were used, no days loss of work and 28 days restricted from diving. Final diagnosis was AGE by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 33

This 24 year old male UDT diver made a SPEC WAR ops dive using open circuit SCUBA. The dive was to 36 fsw for 50 minutes no "D" two minutes after surfacing this divers buddy experienced nausea and vomiting. A rapid upward excursion of approximately 12 fsw occurred during submarine lock in lock outs. A diagnosis of AGE could not be ruled out on the other diver so both divers were compressed to 165 fsw. 6 minutes after reaching treatment depth the afflicted diver was asymptomatic and neuros were normal in both divers. The divers air was obtained from the submarine's hp flasks and contamination could not be ruled out. An air sample was never recovered due to a mix up of SCUBA bottle during the transport of divers. No drugs were used one day loss of work and 30 days restricted from diving. Final diagnosis AGE by DMO.

NMRI Diagnosis: Definitely not decompression illness

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 34

This 21 year old UDT diver made a SPEC WAR ops dive using open circuit SCUBA. The dive was to 36 fsw for 50 minutes. Two minutes after surfacing this diver experienced nausea and vomiting. A rapid upward excursion of approximately 12 fsw occurred during submarine lock in lock out. A diagnosis of AGE could not be ruled out. This diver was compressed on to (*sic*) 165 fsw where he had complete relief after 6 minutes at treatment depth. A neuro was conducted at depth and was reported as normal. The divers (*sic*) air was obtained from the submarine's HP flasks and contamination could not be ruled out. An air sample was never recovered due to a mix up of SCUBA bottles during the transport of the divers. No drugs were used, one day loss of work, 30 days restricted from diving, final diagnosis AGE by DMO.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 35

This 18 year old male 2nd class diver made a searching dive using MK XXI air. The dive was to 26 fsw for 61 min. no "D". The members head being too small for the liner the oral nasal mask did not make a proper seal. This caused the mask to free flow. From 21 fsw to the surface this happened 3 times. Approx. 20 minutes after surfacing the diver noticed that he was feeling unusually tired he did not report this. 45 mins later he was found asleep. Upon being awakened it was noted that he had poor balance. A neuro produced a poor Romberg and patient was deteriorating rapidly. Compression to 165 commenced and complete relief was obtained at 100 fsw. A TT, (sic) 6A was completed. No meds were used, 3 days loss of work, 30 days restricted from diving, final diagnosis was AGE by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 36*

This 27 year old male 2nd class diver made a ships husbandry dive using ESDS air. The dive was to was to (sic) 37 fsw for 2 hours and 56 minutes no "D". Approx. one hour after surfacing the diver reported fullness around the neck, slight discomfort under sternum and tingling in left thoracic area. Initial neuro was normal. 25 minutes after the initial symptoms the diver reported pain in the left wrist. Another neuro revealed weakness in left leg. He was compressed to 60 fsw for treatment where the diver failed a Rhomberg Test. He was taken of (sic) O2 and compressed to 165 fsw (sic) All symptoms resolved at treatment depth. The Diver was treated on a TT 6A, and I.V. of Ringers Lactate was given. One days loss of work, 6 weeks restricted from diving, final diagnosis AGE by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 37

This 23 year old 2nd class diver made a ships husbandry dive using MK 21 air. The dive was to 25 fsw for :44 min. no "D". Approx. 20 minutes after surfacing this diver experienced weakness, dizziness and fatigue. The dive was uneventful except he stated that his hat free floowed (sic) on two occasions during the dive. A neuro showed unsteady gait, Romberg Test was abnormal and a loss of feeling on portions of his back. A chest X-ray disclosed mediastinal emphysema. The diver was compressed to 60 fsw on O2 and had first relief after two minutes at 60 fsw with complete relief after the 2nd O2 period. A TT 6 was completed with one extension at 60 fsw. No meds were used, no days loss of work and 28 days restricted from diving. Final diagnosis possible AGE caused by improper fit of MK 21 diving helmet.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 38

This 25 year old male 1st class diver made a salvage dive using MK 21 air. The dive was to 33 fsw for 2:14 no "D". During the last three minutes of the dive this diver reported sudden onset of nausea, vertigo and headache. He vomited three times on the bottom. After several vents the diver was surface (*sic*). During the up and over phase the diver had trouble holding the ladder. A neuro conducted by the MDV confirmed weakness in shoulder and elbow muscle groups on left side. He was transported on O2 to chamber. Compressed to 165 fsw with first relief at 2 minutes on the bottom. Relief of all symptoms at 29 minutes. A TT 6A was completed. No meds were used, no days loss of work, 28 days restricted from diving. Final diagnosis hypercapnia and AGE.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 39*

This 28 year old male 1st class diver made a ships husbandry dive using ESDS (AGA) on air. The dive was to 34 fsw for 3:11 no "D". Approx 15 to 20 minutes after the dive this diver noticed a loss of hearing in his left ear. No other neurological deficits were noted. Diver was compressed to 165 fsw. EDU was notified of mishap and concurred with treatment. First relief was noted at 1:45 into the treatment at 60 fsw on O2. A TT 6A was completed with no extensions. The diver surfaced with substantial relief. No meds were used, one day loss of work and 30 days restricted from diving. Final diagnosis was AGE by DMO.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 40

This 24 year old female diving officer made searching dive using open circuit SCUBA. The dive was to 40 fsw for 3 minutes. While at depth this diver reported vertigo. The dive was aborted. On the surface she complained of dizziness and severe headache. A neuro revealed neurological deficits heel to toe walk. The diver was compressed to 165 fsw. 1st relief was noted upon reaching treatment depth. Complete relief was noted 2 minutes into the 2nd O2 period at 60 fsw. (*sic*) and I.V. of normal saline and I.V. decadron was given. No days loss of work, 28 days restricted from diving, final diagnosis AGE by MDV.

NMRI Diagnosis: Definitely not decompression illness

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 41

This 20 year old 2nd class diver made a salvage dive using open circuit SCUBA. The dive was to 35 fsw for :51 BT. This diver was not acting normal after the dive. A neuro was conducted. He could not pass the Romberg portion of the exam. 11 minutes after surfacing he was compressed to 165 fsw. :13 minutes into the treatment complete relief was obtained. A TT 6A was completed, no meds were used, one day loss of work and 28 days restricted from diving. Final diagnosis was AGE by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 42

This 3M (*sic*) year old 2nd class diver made a salvage dive using open circuit SCUBA. The dive was to 35 fsw for :52 BT. Approx. eight minutes after surfacing this diver reported muscle tightness (mechanical injury) in the right arm. He was swinging a hammer at depth. A neuro was performed by a DMO. AGE could not be ruled out for his diving buddy showed neurological deficit in his neuro exam. This diver was compressed to 165 fsw 2 and one half hours after surfacing. A TT 6A was completed with full relief noted :10 into the treatment. No meds were used, one day loss of work and 28 days restricted from diving. Final diagnosis was AGE by DMO.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 43

This 21 year old male Navy EOD assistant diver made an EOD dive using open circuit SCUBA. The dive was to 50 fsw for :40 BT no "D". This diver make (*sic*) 3 rapid ascents to the surface from 40 fsw to retrieve buoyant objects. He exceeded 60 fpm on ascent passing his own bubbles. Blood was in his face mask upon surfacing. Symptoms of numbness both hands and feet were noted five hours post dive but not reported until 15 hours after surfacing. He was compressed to 60 fsw on O₂, 1st relief was obtained upon reaching treatment depth, complete relief at 1:00 into the treatment. TT 6 with 1 ext at 60 fsw was completed. No meds were used, one day loss of work and 28 days restricted from diving. Final diagnosis was DCS II by DMO. Note: reported as DCS II. The dive profile and type of symptoms strongly suggest AGE.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type II Decompression Sickness

Case 44

This 37 year old male Navy Sat Diving Officer made a ships husbandry dive using MK 21 on air. The dive was to 30 fsw for :25. After the dive the Diving Supervisor, which was under instruction, performed a training neuro on this diver which revealed a neurological deficit. A lack of communication was aparent (*sic*). The deficit was thought to be manufactured by the diver for the training neuro. The nest (*sic*) day he was evaluated for the deficit. It consisted of personality changes. Lack of coordination and a positive Babinski sign. He was compressed to 60 fsw on O₂. Complete relief was noted :19 into the treatment. An I.V. of NACL was used, 2 days loss of work, 35 days restricted from diving. Final diagnosis was AGE by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 45

This 21 year old male Navy diving student made a training dive using Mark 21 on air. The dive was to 29 fsw for :22 BT. :08 after surfacing this diver complained of a headache. A neuro was normal. The diver stated that his headache was worsening. He was compressed to 165 fsw. He reported complete relief on descent at 18 fsw. No meds were used, no days loss of work and 28 days restricted from diving. Final diagnosis was AGE by DMO.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 46

This 23 year old male SPECWAR Diver made a lock in lock out dive using open circuit SCUBA. The dive was to 29 fsw for 1:14. The diver used a lift bag to float an outboard engine to the surface. Upon surfacing he experienced dizziness. He made a descent for lock in. The neuro was normal except for dizziness. He was compressed to 165 fsw. First relief was noted :02 into the treatment at 60 fsw. Complete relief was noted :10 into the treatment. A TT 6A was completed. An I.V. of Ringers D5W was given. 3 days loss of work, 42 days restricted from diving. Final diagnosis was AGE by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 47

This 23 year old male 2nd class diver made a ships husbandry dive using ESDS on air. The dive was to 35 fsw for 1:55. This diver (red) noted that he was not feeling well on the bottom and turned over his work to his dive buddy (yellow). Red divers (*sic*) condition did not improve. The supervisor recovered both divers. Once on the surface yellow diver reported the same feeling earlier but it cleared. Red diver on the surface complained of nausea and light-headedness. At the chamber a neuro showed short-term memory loss, difficulty in talking and nystagmus. He was compressed to 165 fsw. First relief was noted upon reaching treatment depth and complete relief at 2:14 into the treatment. A TT 6A was completed. No meds were used, no day loss of work and 30 day restricted from diving. Final diagnosis was AGE by DMO. Cranial nerve deficite (*sic*)

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 48

This 23 year old male EOD assistant made an EOD OP dive using open circuit SCUBA. The dive was to 45 fsw for :23 BT. While on the bottom this diver experienced a headache and surface (*sic*). On the surface he had extreme weakness and had difficulty remaining alert. He was examined by DMO and MDV. A diagnosis of AGE was made. He was transported to the chamber and compressed to 165 fsw. Complete relief was noted at 130 fsw on descent. At (*sic*) TT 6A was completed. No meds were used, no days loss of work and 42 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 49

This 40 year old male civilian diver made an inspection dive using open circuit SCUBA and a dry suit. The dive was to 47 fsw for 5M mins. 20 mins after surfacing this diver complained of dizziness and nausea. He was diagnosed as having shallow water AGE by DMO. Recompressed to 60 fsw. First relief occurred (*sic*) 4 mins into the treatment followed by complete relief 5 hours and 36 mins into the treatment. A TT6 was completed. No meds were used. No days loss of work and 30 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 50

This 23 year old male second class diver made a SSBN security swim using surface tended open circuit SCUBA. Diver's tending line snagged on rudder and as he attempted to unsnag himself he made an uncontrollable ascent (8 to 10 fsw) to the surface. Dive profile was 40 fsw for 20 mins. Approximately 3 mins after surfacing diver complained of numbness in lips and facial area. While transiting to the chamber diver reported numbness and loss of strength to left arm and shoulder, dizziness, and blurred vision. Seconds prior to entering chamber diver became unconscious (*sic*). Recompressed to 165 fsw and treated on TT6A for AGE. Complete relief noted 5 M mins into the treatment. 1000ML 2% sodium chloride IV used. Three days later this same diver reported feeling fatigued, headache, back pain and left elbow pain. Neuro exam conducted revealing pain in back of head, pain middle left side of back, poor coordination, tingling left hand, and slurred speech. Diver recompressed to 60 fsw on a TT6. Complete relief noted 40 mins into the treatment. No meds were used. No days loss of work and 2 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 51

This 38 year old male HeO2 diving officer was assisting during a recovery of a DSRV using open circuit SCUBA. His dive profile was 42 fsw for 20 mins. 3 mins after surfacing diver became unconscious and had a grand mal seizure. Seizure lasted approximately 1 min and diver regained consciousness about 15 mins later. Diver medivaced to chamber by helo. Neuro exam conducted with no neurological symptoms noted. Diver recompressed to 60 fsw on TT6 for AGE. Ringers lactated (*sic*) used during treatment. No days loss of work and 42 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 52

This 22 year old male second class diver was patching a wreck using MK 21. His dive profile was 52 fsw for 58 mins. 30 mins after surfacing diver complained of pain in his lower back and stated that he did not feel well. Neuroexam was conducted and a loss of hand to eye coordination and loss of balance was noted. He was recompressed (*sic*) to 165 fsw on a TT6A for AGE. Neuro exam at 165 fsw noted short term memory loss, weakness in the left arm, and drooping facial muscles. Complete relief noted 23 mins into the treatment. No meds were used. Upon surfacing neuro exam revealed roving left eye. Diver recompressed to 60 fsw and treated on TT6. Complete relief noted 19 mins. into the treatment. No meds used. 1 day loss of work and 28 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness or Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 53

This 21 year old male dive student was conducting underwater sonar operations using a hand held Dukane sonar while diving SCUBA. His dive profile was to 22 fsw for 25 mins. Upon handing the sonar to his dive partner he noticed tingling in his 1st and 2nd fingers on his right hand. Two minutes later he aborted the dive and reported his symptoms to the Diving Supervisor. Diver was transported to the chamber and examined by DMO where he was diagnosed as having fatigue/altered (*sic*) sensation to his right hand due to holding the sonar. DO elected to treat the diver for AGE due to neurological symptom being present. Attempted to recompress diver to 165 fsw but diver had problems clearing and descent was stopped at 71 fsw and diver brought back up to 60 fsw and treated on TT-6. Diver had complete relief of all symptoms at 39 fsw on descent. No meds were used. One day loss of work and 28 days restricted from diving.

NMRI Diagnosis: Definitely not decompression illness

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 54

This 24 year old male first class diver made a dive to seal a cofferdam which had developed a leak using MK 20. As the diver was returning to the cofferdam, it blew out a two foot section of the rubber releasing a large air pocket which hit the diver forcing him to the surface. His dive profile was to 28 fsw for 37 mins. Upon surfacing the diver was semi-conscious. A neuro exam was conducted which revealed tingling and loss of sensation in the right upper extremity from the shoulder down through (*sic*) the hand and the left wrist down through the hand. The diver also complained of nausea. Diver was recompressed to 60 fsw and treated on a TT-6 for AGE. Diver had complete relief 22 mins into the treatment. 1000 ml Ringers Lactate and 10 mg Dexamethasone given IV. 1 day loss of work and 28 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 55

This 26 year old male first class diver made a bottom search dive using MK-20 to 35 fsw for 43 mins. 40 mins. after surfacing the diver complained of pain in his left elbow. A neuro exam was conducted and weakness of his left arm and shoulder were discovered as well. Diver was put on O2 and transported to nearest recompression chamber. Diver had complete relief of symptoms enroute to the chamber. Diver recompressed to 60 fsw and treated on TT 6 for AGE. No meds were used. 1 day loss of work and 28 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 56

This 22 year old male second class diver made a dive to inspect a shaft system using SCUBA to a depth of 23 fsw for 44 mins. Approx 26 hours after surfacing diver complained of pain and weakness of left foot and tightness across right chest area. Diver recompressed to 60 fsw and treated on TT 6 for AGE. Diver had complete relief five minutes into the treatment. No meds were used. No days loss of work and 28 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 57

This 26 year old male EOD diver made an open circuit SCUBA dive to 37 fsw for 20 mins using a drysuit. During the dive the diver experienced difficulty controlling the buoyancy of his drysuit. Approx 1 hr after the dive the diver complained of a dull pain in his neck apound (*sic*) the area of the spinal cord. A neuro exam was conducted with no other symptoms noted. Diver recompressed to 60 fsw and treated on a TT6 for AGE. No meds were used. No days loss of work and 42 days restricted from diving.

NMRI Diagnosis: Uncertain if decompression illness or not

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 58

This 22 year old male EOD diver made an open circuit SCUBA dive to 40 fsw for 20 mins. During the dive the diver lost his weight belt and was unable to control his ascent to the surface. Upon surfacing the diver felt disorientated (*sic*). Neuro exam revealed weakness of right arm and leg. Diver recompressed to 60 fsw and treated on TT 6 for AGE. No drugs were used. Diver had complete relief 51 mins into the treatment. No days loss of work and 14 days restricted from diving.

NMRI Diagnosis: Definitely decompression illness (Arterial Gas Embolism)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 59

This 34 year old male Navy SPECWAR SOT tech made a SPECWAR dive using open circuit SCUBA. The dive was to 25 fsw for :40. Forty minutes after surfacing he complained of pain in the left hand. This may have been present during the dive and probably due to a grip maintained during the dive. The exam was normal and told to return if symptoms worsened. Later on that night he noticed paresthesia in the hand, a funny feeling in his left elbow, shoulder and lower back. He called in and was told to report ASAP. The exam this time was positive for neurological deficits. He was compressed to 165 fsw. First relief was noted :11 into the treatment and complete relief :16 later. A TT 6A with extensions at 60 and 30 fsw was completed. No meds were used, 2 days loss of work and 14 days restricted from diving. Final diagnosis was AGE by DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Arterial Gas Embolism

Case 60

This 19 year old male second class Navy diver made a ships husbandry dive using Mark 20. The dive was to 21 fsw for one hour and three minutes, no "D". The next AM while working out at the gym this diver noticed slight numbness and tingling in his right hand. He stopped his exercise and returned to the dive locker. His symptoms exacerbated during transit including numbness and loss of strength in the lower right extremity and a decrease in peripheral vision. The neuro at the chamber revealed six significant deficits. He was compressed to 60 fsw on O2. First relief was noted 8 minutes in to the treatment and complete relief during the second O2 period. A treatment table 6 was completed. No meds were used, no days loss of work and 28 days restricted from diving. Final (sic) diagnosis was DCS Type II by the DMO.

NMRI Diagnosis: Definitely decompression illness (Decompression Sickness)

Naval Safety Center Diagnosis: Type II Decompression Sickness